# Supplier's capacity assessment and performance monitoring on a fashion e-tail company

*Tiago Teixeira*

**Master's Dissertation**

Supervisor at FEUP: Prof. Paulo Osswald


**Mestrado Integrado em Engenharia Industrial e Gestão**

2015-07-01

*"Experience is merely the name men gave to their mistakes."*

Oscar Wilde

## Abstract

The main goal of this project is helping Farfetch, a luxury e-commerce fashion retailer, improve its partner boutiques performance, especially in the time it takes them to process an order. If a boutique underperforms, the service provided to the customer loses quality. Due to the constant growth in sales and the concentration of demand in short periods of time, new methods and tools should be developed. These should allow a proactive stance, instead of the current reactive stance of the company.

To prepare the boutiques for increased demand during peak periods, two approaches were taken. The first one resulted in a tool that allows the assessment of the boutique maximum processing capacity with its current resources. It is based on past data and the analysis of the boutique's processes. The second also resulted on a tool, which is based on demand forecasts for the specific boutiques within Farfetch-led campaigns. Integrating the second tool with the boutique capacity assessed with the first tool, Farfetch is able to signal the boutiques that need to reinforce their capacity and warn them. These methods were integrated in Microsoft Excel worksheets via Visual Basic for Applications and Standard Query Language queries, allowing its usage throughout the company.

To reduce situations of underperformance during periods of normal demand, a new leading indicator called Boutique Score was developed. This indicator aims at the detection of potential underperformance situations before they actually occur. If these situations are early detected, it is possible for boutiques to take preventive actions.

Using the 2 tools developed, Farfetch is now able to pass valuable information to its partner boutiques regarding on how they should prepare themselves for peak periods in demand. The results obtained so far have been positive and the boutiques performed consistently better during the new sale season when compared to previous ones, with the *speed of sending* metric remaining always above target.

## Quantificação da capacidade de fornecedores e monitorização de desempenho numa empresa de retalho de moda *online*


### Resumo

O principal objetivo deste projeto é ajudar a Farfetch, uma empresa de retalho de moda *online*, a melhorar o desempenho das suas boutiques parceiras, especialmente no tempo que demoram a processar uma encomenda. Devido ao constante crescimento das vendas e concentração da procura em pequenos períodos de tempo, novos métodos e ferramentas devem ser desenvolvidas. Estas devem possibilitar a adoção de uma postura proativa ao invés da atual postura reativa da empresa

Para preparar as *boutiques* para uma maior procura durante períodos de pico foram seguidas duas abordagens. Da primeira resultou uma ferramenta que permite a avaliação da capacidade de processamento máxima de encomendas de cada *boutique* com os recursos que emprega atualmente, baseando-se em dados do passado e na análise dos processos das *boutiques*. O segundo também resultou numa ferramenta, que utiliza as previsões de procura para *boutiques* específicas, que participem em campanhas desenvolvidas pela Farfetch. Cruzando os resultados obtidos por ambos os métodos, a Farfetch pode sinalizar as *boutiques* que precisam de reforçar a sua capacidade e notificá-las. Estes métodos foram integrados em folhas de *Microsoft Excel* através de código em *Visual Basic For Aplications* e em *queries* programadas em *Standard Query Language*, o que permite o seu uso por toda a empresa.

Para reduzir as situações em que a *boutique* falha no seu desempenho, um novo indicador avançado denominado *Boutique Score* foi desenvolvido. Este indicador tem como objetivo a deteção de potenciais situações de não desempenho antes de ocorrerem. Se estas situações forem detetadas com antecedência, é possível que as *boutiques* tomem ações preventivas.

Usando os 2 métodos desenvolvidos, a Farfetch pode agora passar informação valiosa às suas *boutiques* parceiras, relativamente ao modo como se devem preparar para períodos de procura intensa. Os resultados obtidos até então têm sido positivos e as *boutiques* têm tido um desempenho consistentemente melhor durante a nova época de saldos, com a métrica de velocidade de envio a manter-se sempre acima do objetivo.

## Acknowledgments

A journey is never made alone and I was lucky to always have someone by my side supporting me.

A company's quality depends on its persons and Farfetch is the biggest example of that. Words can't describe how thankful I am for all the support I had during this project from everyone in the company. A special note of gratitude goes to the most requested person in the whole company, my supervisor Nuno Borges. His thinking ahead, long term vision and pedagogic stance were determinant to the development and conclusion of this project. I would also like to express my gratitude to Raquel Marinho for never letting a question go unanswered, even if it meant stopping her work. I would also like to thank Luísa Ribeiro and Nuno Carvalho that were with me from day 1 in this adventure.

I would like to thank my supervisor at FEUP, Professor Paulo Osswald, for all the guidance and valuable input throughout this project.

This dissertation would have never existed without everyone that made these last 5 years the best of my life. To everyone that was already here when I arrived, thank you for all the values you passed and the support you gave me. To everyone that got here after me, thank you for all the laughs, sincere words and never ending friendship. To all the "Verdadeiros" that walked this path with me, there are no words powerful enough to express how grateful I am. You've grown with me, you've helped me become who I am and you made every cliff in the way seem like just a small leap. I can truly say that I would not be where I am today if it wasn't for you.

A big thank you to Isabel Pereira and Beatriz Alves that have been with me ever since I remember.
Last but not least, I'd like to thank my parents and my brother for unconditionally supporting and believing in me.

# Table of Contents

## Acronyms

AM – Account manager

AWB – Airway bill

AW14 – Autumn winter 2014 season

BP - Business process

DB - Database

FIFO – First in first out

KPI – Key performance indicator

NPS – Net promoter score

PS – Partner services

SKU – Stock keeping unit

SOS – Speed of sending

SQL – Structured query language

SS14 – Spring summer 2014 season

SS15 – Spring summer 2015 season

# List of figures

# List of tables

# 1 Introduction

The present dissertation was developed within the supply operations department of Farfetch, a luxury fashion e-commerce company. Its main goal is the improvement of the partner boutiques overall performance, namely in the time it takes them to process and ship an order. In an e-commerce business, the time an order takes to reach the customer is one of the most fundamental factors for client satisfaction. Since Farfetch never enters into direct physical contact with its customers, reducing this time is essential. In figure 1, it is possible to see the two parts that influence the time an order takes to reach the customer.


Figure 1- Representation of the time an order takes to reach the customer

Controlling the time a partner boutique spends processing an order is thus essential for the improvement of the customer satisfaction and customer retention in Farfetch's business model.

## 1.1 Farfetch

Farfetch is an online marketplace for luxury fashion launched in 2008. It has grown continuously, more than doubling sales each year, reaching 293 million euros as of 2014. It is marketed for "fashion lovers, not followers" and globally sells items from more than 300 European, Asian and American high-end boutiques, such as Biondini Paris, Stefania Mode, Browns or American Rag. It also offers editorial content showcasing its independent take on the irreverent and ever changing world of independent luxury fashion.

Farfetch differentiates from other fashion e-commerce companies through its business model. All the items sold through its website are owned and kept by the boutiques themselves. Each product sold is collected by an external courier provider and directly delivered at the customer's home. No product is ever stored or bought by Farfetch. All the operations are managed by the company as part of its service.

The company's service operates as a bridge between its partner boutiques and customers. Everything, from photographing the products for the catalogue to post-sales customer service, is offered as part of the Farfetch service. Within the operational part of sales boutiques only need to pack the items. This way, Farfetch offers boutiques a fully developed and supported sales channel, with a much wider scope than a solely physical space can have and a hugely wider scale than own on-line sales.

To the customer, Farfetch offers the ability to choose and buy from more than 1000 brands, offered by a community of boutiques, *carefully selected for their forward-thinking attitude, unique approach to merchandising and diversity of brands.* (source: http://www.farfetch.com/pt/pag1988.aspx? seen in: 24/04/2015).

No company has been able to successfully replicate Farfetch's business model. Due to the high number of boutiques involved, Farfetch is able to effectively obtain very competitive costs through economies of scales. Given the magnitude of the service, it is very unlikely that single boutiques are able to offer a similar service and still be profitable.

Yet, there are other luxury fashion e-commerce retailers. Farfetch has two major advantages when compared to these retailers. First, the company holds no stock. This way, Farfetch has no inventory holding costs and won't lose any money if a product sells less than expected. Second, since Farfetch partner boutiques are very diverse and from different cultural backgrounds, it is able to offer 5 times more products than a regular e-fashion business.

Currently, Farfetch has more than 600 employees and operates 9 offices in 7 different countries: Portugal (Porto and Guimarães), United Kingdom, United States of America (New York and Los Angeles), Brazil, Japan, Russia and China. Each office deals with different aspects of the business. This dissertation was developed in Porto's office where approximately half of Farfetch employees work. There are 8 departments in this office:

- IT;
- Operations;
- Account Management;
- Partner Services;
- Human Resources;
- Merchandising;
- Finance;
- Customer service.

Two departments are mainly responsible for all the contacts between Farfetch and the partner boutiques. They are the Account Management (AM) and Partner Services (PS). Customer Service also contacts boutiques whenever the question is straightforward. AM is responsible for all the commercial aspects related to the partner boutiques. They advise the boutiques on which brands and items should be bought to maximize sales. They also coach boutiques on the processes they need to perform. PS is responsible for solving day-to-day problems related to order processing. It also works as the mediator between the customer and the boutique when the first complains about an order. Both these departments in Porto's office are responsible for all the boutiques that are in Europe and Asia (minus Japan) which account for roughly 90% of Farfetch sales.

The operations department main responsibility is ensuring that each order is successfully fulfilled within a reasonable time. This department is divided in 3 different teams: Courier, Fraud and Payment and Supply.

The supply team, where this thesis was developed, deals with all the operational aspects related to the boutiques. Its main objective is controlling the boutique's performance and ensuring that service levels are maintained. To do this, the supply team collaborates with the Account Management and Partner Services department working on the improvement of boutique's setups and also on the definition of best practices for the boutique's order processing. The main actors in Farfetch, responsible for the boutique performance improvement can be seen on Figure 2.

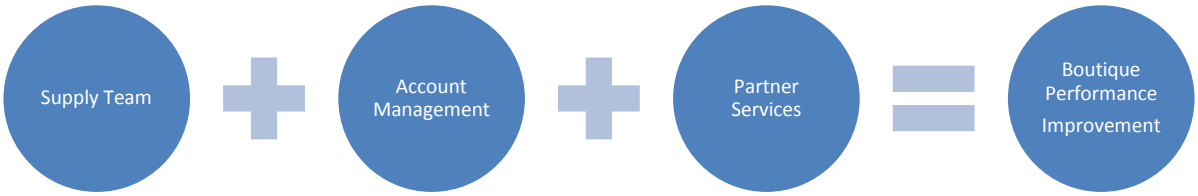



Figure 2 – Actors responsible for the boutique performance

The supply team also collaborates with the IT department on every project related to order processing and the development of new tools for the boutiques.

## 1.2 Project Objectives

One of Farfetch's main advantage is also its biggest disadvantage. The fact that all the stock is kept by the boutiques means that Farfetch depends on them to successfully fulfil each order. Therefore, Farfetch must work closely with its partner boutiques to guarantee good service levels. The present dissertation is focused on the analysis of the partner boutiques performance.

Two main objectives were set. The first consisted on the preparation of the partner boutiques for the Spring/Summer 2015 sale season. To fulfil this, two tools were developed. One is a method that assesses the order processing capacity of the partner boutiques. The second is a Microsoft Excel macro that, based on demand forecasts, calculates how many orders each boutique must send each day. The combination of both tools allows the Operations department to pre-emptively warn the stores that they must adjust their capacity to face increasing demand.

The second objective aims at an early detection of boutiques' non-performance situations, due to unexpected issues. To achieve this, a new leading indicator called Boutique Score was developed.

## 1.3 Methodology

To develop a better understanding of the key metrics and basic boutique characteristics, the first stage of the project consisted on the analysis of 3 different types of boutiques. The boutiques were chosen because each of them represented well a distinctively typology of boutiques. After this stage, more boutiques were analyzed in the same way, in order to confirm the findings made with the first analysis.

The next phase consisted on the development of the tools used to prepare the boutiques for the Spring Summer 2015 sale season. As both of them were implemented the same way – through a Microsoft excel macro – the same methodology was used for both.

Firstly, the system requisites were defined. Then, the raw method was developed, taking into account the behavioural characteristics observed during the initial analysis. This first method prototype was then tested with some boutiques. Taking into account the errors and specific cases found during the tests, the tool was adapted. After this stage, with a more robust method, the needed SQL queries and macros were programed.

These methods were developed and tested until the middle of April, so they could be used to prepare the stores to the Spring Summer sale season, which starts by the end of May.

The development of the new indicator started with the definition of its objective and how it should be presented. Afterwards, there was the need to decide how the metric should be constructed. It was decided that it would account several factors. The existing data was analysed

and a few factors were chosen. Then a more refined analysis was made and the final factors and their weight in the indicator were defined. This analysis took into account the top 60 boutiques in terms of order volume.

The new indicator was tested in real time, during two promotional campaigns that occurred during April and May. The weights used for each factor on the indicator were adapted according to the results.

## 1.4 Dissertation's Structure

The remaining of this dissertation is structured in 4 different parts. Chapter 2 is a brief review of the methodologies and concepts relevant to this project.

In chapter 3, a general overview of the company's business model is made, beginning with a description of Farfetch's catalogue production process. Then, the processes involved in order processing are explained, in their initial state, at the time this project started. Afterwards, the KPI used within the supply team to evaluate the boutiques are explained. Finally, the boutiques are divided into typologies and each is explained in detail.

Chapter 4 is divided in 3 parts. The first part is dedicated to the boutique capacity assessment method. The method definition is thoroughly explained as well as how it was adapted to be coded and used. The second part is dedicated to the boutique capacity needs tool. It follows a similar structure to the part before. The last part describes the new leading indicator Boutique Score definition and testing.

Chapter 5 concludes with some considerations about the project and discussion of the obtained results. Also, some future works are proposed based on what was found during the project.

# 2 Literature review

Within this chapter, a brief overview of the literature on the key aspects relevant to this project is done. The following 4 subjects are addressed:

- Luxury e-commerce;
- Supply chain management and KPI design;
- Forecasts in the fashion industry;
- Business process modelling.

## 2.1 The Luxury E-commerce

Luxury products have been consumed for centuries and can be defined as status goods, of which the exhibit alone brings prestige to the user (Husic and Cicic 2009). They are used as the expression of indirect social stratification (Okonkwo 2009) and are consumed for their psychological values instead of their practical utility (Doss and Robinson 2013). They showcase an individual ascension in society.

Luxury brands tend to believe that their consumers won't perceive their products as luxury products if they are not expensive. Their higher price makes individuals feel part of the rare elite that can afford these products. As part of the luxury experience, brands try to enhance their customer experience by offering a fancy packaging, higher quality products and exclusive store locations (Husic and Cicic 2009).

E-commerce and luxury fashion retail aren't naturally complementary. E-commerce is a very unique and particular distribution channel since it lacks any physical or technological boundaries (Okonkwo 2009) and offers consumers information about brands and products without almost no time or space constraints (Larraufie and Kourdoughli 2014). On the other hand, the luxury world tends to be associated with exclusivity (Larraufie and Kourdoughli 2014) and every customer expects to have special and focused treatment. Brands and retailers fear that by going online they'll become too available and will stop being recognized as a luxury brand (Bjørn-Andersen and Hansen 2011).

Yet, in spite of their reticent attitude, luxury brands were forced to expand online after the economic downturn of the late 00's, when physical stores sales declined whereas e-commerce attained double digit growth (Okonkwo 2009).

To successfully establish themselves and thrive in the online business, luxury brands and retailers must focus on finding ways of allowing customers to interact with them, while retaining brand integrity and exclusivity (Bjørn-Andersen and Hansen 2011). They must be able to deliver to a virtual customer the juxtaposition of image, emotion and perception that defines luxury (Kapferer and Bastien 2009).

In a traditional brick and mortar retail space, the Pareto principle of 80% of the sales coming from 20% of the products is applied. If the distribution and storage channels are large enough, a company might benefit from the long-tail market. This represents the usual 80% of the

products that don't generate a large volume of sales plus all the products whose demand is so sporadic that it is not kept in stock. An e-commerce company, benefiting from the low communication costs and no geographical limitations, is able to take advantage of the long tail market, which might match the sales value of the remaining products (Cao and Ye 2007).

## 2.2 Supply Chain Management

There is no generally accepted definition of supply chain management (Mouritsen, Skjøtt-Larsen, and Kotzab 2003). A common definition is a *network of organizations that are involved, through upstream and downstream linkages in the different processes and activities that produce value in the form of products and services in the hand of the ultimate consumer (Christopher 1999)*. It can also be seen as all the business processes involved in the making and delivery of products/services from the supplier to the end customer (Jan, Tage, and Herbert 2003). It is an integrated approach to the flow of materials and information between all the companies that participate in a product/service flow. It can be concluded that businesses are no longer seen as autonomous units but as parts of supply chains (Chen and Paulraj 2004).

Both definitions highlight the broadness of the term, given the number of companies involved. Managing such a large and complex system is challenging, yet essential for a company to achieve a long term competitive advantage (Li et al. 2005).

To effectively manage their supply chains, companies must focus on 3 important aspects of supply chain management. These are: long term relationships with suppliers, logistics integration and supplier assessment (Prajogo et al. 2012). All these aspects will be further detailed.

The relationship between suppliers and buyers is characterized by the interactions between both (Paulraj and Chen 2005). A better relationship means that the intervening parties trust each other and are aware of their importance to their success. With a good relationship both are more willing to take risks together and align their strategies leading to improved overall effectiveness (Xuan and Yuanzhang 2007).

On its essence, logistics integration is the well-coordinated flow of materials downstream, which allows the companies to have a smooth production process. To achieve this, companies must share internal information, namely about sales, forecasts and stocks and coordinate logistic activities (Gimenez 2006). As a result, it is expected that companies and their suppliers work as a single entity (Prajogo et al. 2012).

Supplier assessment is the process of selecting the company's suppliers based on the evaluation of the potential supplier's performance and capability. In this definition, performance is the supplier's ability to meet the buyer requirements both in terms of cost, quantity, quality and flexibility. Capability refers to the supplier's potential. In other words, how much more can a supplier deliver in the long term (Sarkar and Mohapatra 2006).

Having the most fitting suppliers to its business/product is crucial for a company to survive. Without assessing its suppliers the company won't be able to optimize its supply chain. This leads to unnecessary costs and unused potential. The use of advanced supplier assessment methods and monitoring performance tends to increase profitability and product quality (Ittner et al. 1999) and has a positive impact on the buyer's performance (Krause, Scannell, and Calantone 2000).

Various techniques have been tried in supplier assessment, yet the scoring method using fuzzy measures is still the most used (Sarkar and Mohapatra 2006). A fuzzy measure is "*a numbered response scheme (…) which corresponds to the conversion of linguistic labels into fuzzy numbers" (de la Rosa de Saa et al. 2015).* This happens mainly because there is the need to use qualitative measures that are hard to translate into numerical data. The biggest liability of this

method is that each person has its own interpretation of the scale, which leads to biased data (Kwong, Ip, and Chan 2002).

Supplier evaluation is a continuous and critical task for managers. Buyers must keep monitoring supplier's performance and capability even after they are selected. With the data acquired during the monitoring, buyers must provide feedback to their suppliers. This way, they encourage them to improve their performance and adapt their processes to the buyer's needs (Prajogo et al. 2012).

To ensure a good performance, the entire supply chain must be evaluated and monitored. Traditional measures fall short when evaluating the entire supply chain as they don't capture the complexity of the system. This can be explained by the fact that they mainly consist of financial metrics, which don't measure accurately operational performance. Also, traditional measures fail to evaluate the supply chain as a whole entity. (Theeranuphattana and Tang 2007).

Decision makers must focus their efforts on developing integrated measurement metrics that are able to effectively evaluate such a complex system. Once these performance managers are adequately developed, managers must detect which crucial key performance indicators (KPI) have to be improved. KPI are a measure tool of performance, used to evaluate the company's progress towards its long-term strategic goals.

One of the biggest difficulties in this lies in understanding and finding out the relationships between KPI. Without the full understanding of these relationships, it is difficult to establish which KPI are critical and what actions should be taken to improve the supply chain performance (Cai et al. 2009)

Another challenge to decision makers is assessing the importance of individual performance measures. Since some measures aren't dynamic they fail to adapt to the ever evolving conditions of the supply chain. Normally, once the measures are developed, they are included in the system and aren't changed for a long time. Another problem is that systems usually don't include a method that, according to the goals of the company and evolving situation, prioritize the measures (Davison and Tse 1999). Therefore, it is important that companies keep updating their supply chain measurement systems and changing the used measures.

As many measurement systems fail to align strategies and offer a balanced approach, some methods of evaluating supply chain performance were developed, mainly the Balanced Scorecard (BSC) and Activity Based Cost (ABC).

The Balanced Scorecard is a strategic planning and management system, helpful for decision-making. It analyses the company from four perspectives: the financial perspective, the learning and growth perspective, the internal perspective and the customer perspective. Within each perspective, the key processes are identified and some strategic goals are defined. For each goal, metrics must be defined, so the accomplishing of the goal can be measured (Yan, Suozhu, and Like 2008).

With the right set of metrics established and aligned with the company strategy and goals, it is much easier to identify and assess the effects of bottlenecks and the source of them. Once this is identified, direct actions can be taken, improving overall supply chain performance. Measuring performance and goal achievement is essential if a company wants to improve their performance. Hence the importance of setting the right and most appropriate key performance indicators.

The KPI design cycle can be divided in 3 parts: mining KPI, analyzing and designing KPI network, and transforming and deploying KPI (Abe, Jun-Jang, and Li 2007). Mining KPI refers to process mining, which is a technique that explores processes flows. Through this technique and using historical data, it is possible to access which variables are more correlated with the goals the company wants to achieve. Usually several KPI correlations are identified. In the next

stage, the possible KPI are further studied and their number is reduced, through a series of business-oriented analytic methods. The final product of this stage is a network of KPI elements and the relations between them. In the last phase the KPI start being used by the company.

Good key performance indicators must follow the SMART rule (Gang et al. 2010). This means that they must be:

- Specific;
- Measurable;
- Attainable;
- Realistic;
- Time bound;

Some other conditions must be decided during this period since they directly affect the KPI effectiveness. These are the context of the KPI, as to when it should be evaluated and who should monitor it. The last condition is particularly important since the same KPI might be perfect if monitored, for example, by an operational manager and terrible for a upper level manager (Abe, Jun-Jang, and Li 2007).

KPI provide a way of aligning the entire organization with the company strategy. KPI must be presented to the upper level management in an effective and clear way. This way, these managers will be able assess the current situation in a fast manner and evaluate the strategic objectives achievement (Liu, Xue, and Su 2009). There are several methods for reporting. Dashboards offer supply chain performance focused companies a simple and effective way of presenting KPI.

A Dashboard is a tool prepared for the busy leaders. An effective dashboard allows them to quickly assess the company's performance by simply looking at it. It must provide the information about the current status of the company in a simple, intuitive and graphical way (Meyliana, Widjaja, and Santoso 2014).

Indicators that are measurable precursors to events are called leading indicators. The indication given by these indicators comes before the actual event. These indicators are said to be proactive, since they enable pre-emptive actions. On the other hand, lagging indicators or "loss metrics" only become apparent after the event happens. These are reactive indicators as possible measures can only be taken after the event happens. (Reiman and Pietikäinen 2012)

## 2.3 Sales Forecast in the fashion industry

Forecasting is the prediction of future demand, usually based on past data. Forecasts are essential in the fashion industry mainly for two reasons. First, a good forecast avoids situations of understocking, which represent lost sales and dissatisfaction of customers, and situations of overstocking, which represent bigger stock costs and items that need to be sold with big discounts. Second, the fashion supply chain is extremely long and spread across the globe, ranging from the cotton plants to the wholesalers and retailers. This means that production must be planned ahead and eventual changes take long to be in place (Liu et al. 2013)

Traditionally statistical models were widely applied for forecasting. These models are usually fast and have proven to be effective if the right model and appropriate parameters are chosen. The precision of these models is dependent on the expert's knowledge and the non-existence of unidentified hidden patterns in data. As this limited the applicability of these models, artificial intelligence methods started to be used. These methods offer more precise results yet they require more computation capacity and take longer time (Yu, Choi, and Hui 2011).

Forecasting demand is always an activity marked by uncertainty, especially for fashion, due to several factors. The demand is dependent on the customer tastes and the trends, which are

highly unpredictable and hard to detect until the beginning of the season. Each season the designers reconstruct their collections, choosing new patterns, fabrics and colours leaving historical data useless, unless it possible to establish relevant relationships between product's attributes. Another problem is that there is a very high number of stock keeping units (SKU) given the color/size combinations available (Yesil, Kaya, and Siradag 2012). Also, the fashion product lifecycle is very short, usually only lasting for a season, and the demand is highly volatile. This means that an item might have low sales at the beginning of the season, have a peak during the middle lasting a few weeks and then return to the demand levels of the beginning of the season (Liu et al. 2013).

Another problem is the forecasting horizon. Most forecasting models used today are appropriate for middle term and long term forecasting (Liu et al. 2013). Yet, given the volatile demand and the impossibility to infer tastes and trends until the beginning of the season, short-term forecasting is essential. Also, for operational purposes, short-term forecasts are important for logistics planning and working schedules definition.

## 2.4 Business Process Modeling

Companies have been shifting the view on their operations from the traditional functional viewpoint to a process orientated view, leading to a better integration of their operations. A process is as a sequence of tasks. It has a well-defined beginning and end, and its inputs and outputs are identifiable. Depending on the information required, a process might be looked at from different perspectives. The most common are the functional view, the informational, the behavioural and the organizational (Bal 1998).

Business process modelling is an approach to graphically showcase the way organizations conduct their business processes. It is vital for the analysis and to the design of IT systems that are process aware. It is also vital to the organizational documentation, business process reengineering and the construction of service-orientated architectures. These models typically illustrate in a graphical way the activities and control the logic flow within a business process. Other usually included information is related to the involved data and the organizational and IT resources (Indulska et al. 2009).

The purpose of business process modelling is to analyse the current processes in form of an As-Is model and, with the identification of problems, to seek solutions that create added value. Detecting differences between the guidelines and the actual practices helps the company reengineer their processes. With this, the companies are able to align their processes with their actual strategic objectives (Sharma, Hitesh, and Rao 2014)..

As a means of aiding this process, through a visual tool, process maps are used. These maps picture work processes and show how inputs, outputs and tasks are linked. The actors involved can be identified. A process map can be shown at various levels of detail. They should be developed using a top down approach: One should start by mapping the process from a macro level of the process and then proceed to a lower level. The last level should correspond to the mini-level, that shows all the details of the process (Anjard 1996).

Several notations have been developed to model business processes (BP), including UML activity diagrams, event process chains (EPC) and business process modelling notation (BPMN). BPMN is widely accepted as the standard for modelling BP (Sharma, Hitesh, and Rao 2014).

Nowadays, company's employ Business process management systems that are identified as a *generic software system that is driven by explicit process designs to enact and manage operational business processes*. These systems should be generic so it is possible to change the processes it supports. Some of the most common business process management systems use

labels like Workflow Management (WFM), Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), etc. Given the constant evolution of companies and of the technology available, the business process management systems must keep evolving. Therefore, the business process management system cycle can be defined as seen on Figure 3 (Weske, van der Aalst, and Verbeek 2004).

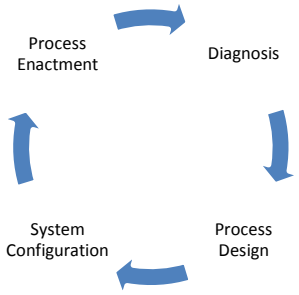



Figure 3 – Business process management system life cycle. source:(Weske, van der Aalst, and Verbeek 2004)

# 3 Current Processes

Within this chapter, the company's processes and situation at the start of this dissertation are explained.

## 3.1 General production process overview

Farfetch's production process refers to everything that happens since a boutique sends the items to be photographed until the items are available at the website. It's necessary to understand the production process as it's the backbone of the whole company.

Stores send slots (parcels with up to 50 new items) to Farfetch production centers. Even though there is no production in the traditional sense, these are called production centers since it's where Farfetch's catalogue is produced. They are usually sent at the beginning of the season, where up to 1600 items are received each day. Some boutiques send items every week. The slots are processed by the logistics department, who categorize the items by season, gender, colour and fabric, among other characteristics. To avoid wasting resources, each item is verified to check if it is already online. This item is called a duplicate. Boutiques are encouraged to check the website before they send the items to be produced. If they find out that the item is a duplicate, they can associate themselves to the item and immediately start to sell.

The slots are divided into rails, according to 3 categories: menswear, womenswear and accessories. Each rail can only contain items from one slot. Afterwards the rails are sent into the photographing studios. There they are photographed in still and in live model.

All the photographs are then edited, polished and go through quality control. If they are approved, the items go back to the logistics department and are packed and sent back to the stores.

All Farfetch orders sent by boutiques must be packed in Farfetch boxes. The minimum adequate size is decided during the production phase, although boutiques may not follow the decision. To save space, the boxes were designed so they could be stored in large volumes when not mounted.

## 3.2 Ordering Process

Farfetch has developed an application that boutiques use for order processing. The application is called FFDM (Farfetch's Desktop Manager Application). It's the main application used by boutiques to process orders. In it is possible to see the orders that they have to process and in which phase of the processing the order is. It can be also used as a stock control tool.

Once the customer places an order, the system generates a portal order, with the customer's purchase information. Then the system splits the portal order into boutique orders, according to the boutiques associated to the items in the order. Each portal order may have an unlimited number of associated boutique orders. A boutique order can only be associated to one portal order. The remaining ordering process is divided into 6 steps as shown on Figure 4.

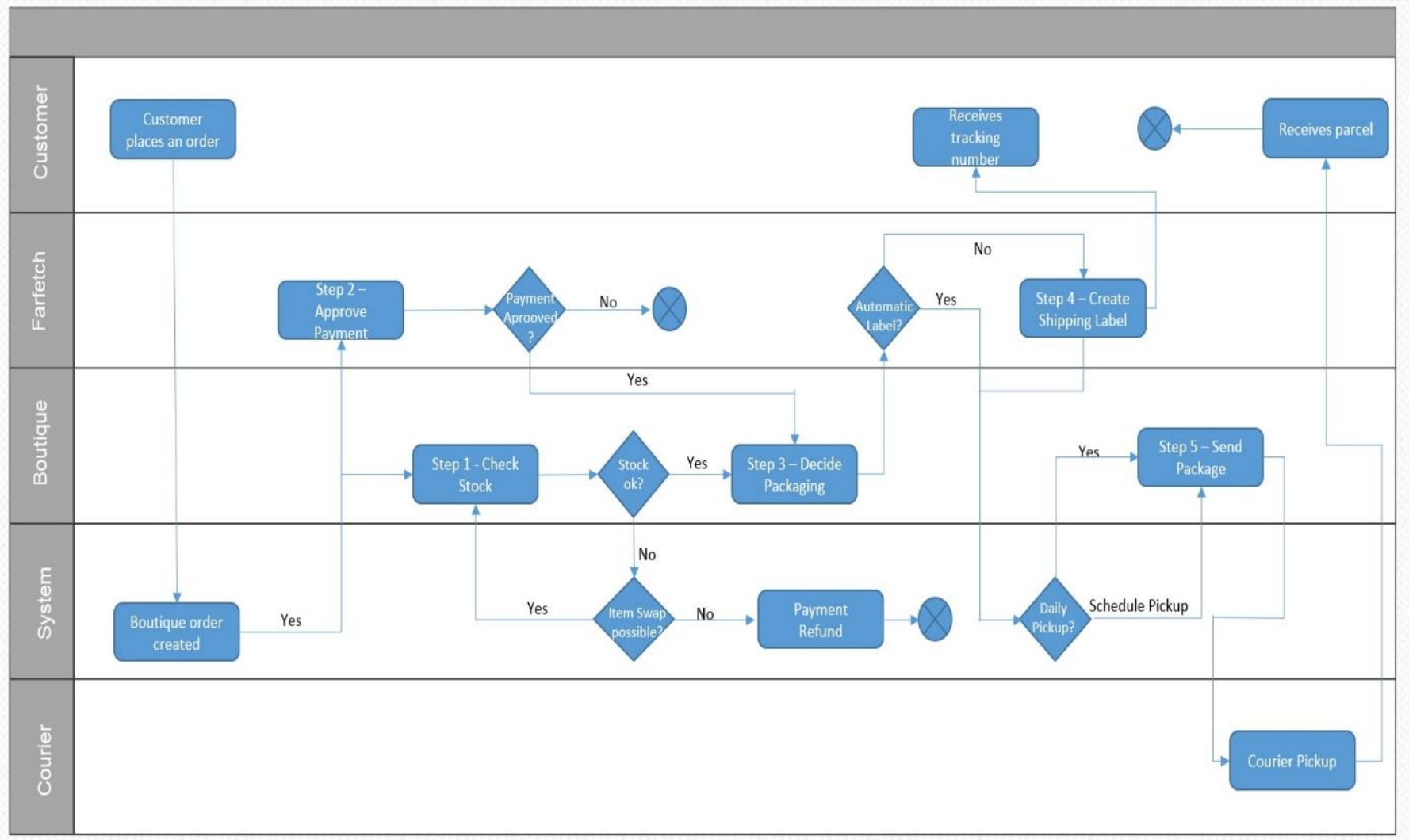



Figure 4 - Order processing map

These steps can be split into 3 categories according to whoever is responsible for them. Check Stock, Decide Packaging and Send Package are Boutique Steps since they are directly handled by the boutiques. Approve Payment and Create Shipping Label are Farfetch steps as they are performed by Farfetch. Step 6 is a Courier step as it is handled by the delivery company. Both Boutique and Farfetch steps are further described below.

**Step 1 - Check Stock**

Once a customer places an order the boutiques responsible for satisfying the request are notified and must confirm whether they have the items on stock or not. Farfetch keeps track of the boutique's stock level but the system isn’t 100% reliable. A physical shop sale may occur between the moment the customer places an order and the moment that the boutique's employees update the online stock. There can also be an error during inventory count. The situation when an item sold by Farfetch is found to be out of stock is called *no stock*.

When a *no stock* happens, the boutique may suggest an alternative to the customer, through Farfetch's Customer Service department. If the boutique decides not to do it and the original item is a duplicate, another boutique that also sells that same item will receive the order. This is called an *item swap.*

Since Farfetch holds no stock an Application Programming Interface (API*)* was developed to reduce no stock frequency. This API is called *Stock Sync* and connects directly the boutique’s own stock management tools with Farfetch’s virtual stock. This way when a physical sale is made, the online stock is automatically updated. Currently, 9 out of the largest 10 boutiques use stock sync. Boutiques that don’t use stock sync, control their stock through a module present in the boutique FFDM.

**Step 2 - Approve Payment**

This step occurs simultaneously with step 1 and it's a Farfetch step. Due to the high volume of orders, step 2 is handled with the help of an automatic flag system. When an order enters the system it is automatically assigned a flag, according to some criteria. With this system, the orders are roughly divided into 3 groups.

The first group consists of recurrent Farfetch users and users whose credit card information is reliable. This group has their payment automatically accepted. First time users or recurrent users whose behaviour might seem strange majorly make up the second group. In these cases, a Fraud analyst investigates the situation and assesses whether the payment is fraudulent or not. The third group consists of previously blacklisted users and credit cards that are known to have been phished. These orders are automatically cancelled.

Since this is mostly an automatic step, the payment is usually approved before the boutique checks that they have the item in stock.

**Step 3 - Decide Packaging**

Once step 1 and step 2 are completed, the order is automatically moved to step 3 and the boutiques are notified via FFDM. The boutiques must decide which kind of boxes and how many they should use to pack the order. The boutique may add something like a handwritten note to the box in order to personalize the delivery and enhance the customer experience.

All boxes are designed by Farfetch and are kept in stock by the boutiques. The stock level of boxes is managed by the boutiques themselves and it is up to them to order the boxes from Farfetch once the stock is low.

**Step 4 - Create Shipping Label**

This step is almost always automatic and consists on the creation of the order's Air Waybills (AWB). Sometimes there is the need to manually create the AWB, usually if the shipping address is incorrect or if by some mistake a duplicate is created of an already in use AWB. The Operations Courier Team, currently existing in Portugal, Brazil, United States of America and Japan, handles these situations.

**Step 5 - Send Package**

The boutiques aren't required to give any signal that the order is packed. Some boutiques start packing the order when they do step 3 while others only do it at a predetermined time before the courier arrival schedule. This way, there is no direct data from which one can infer the packaging time (the time it took the boutique to pack the item).

Once an order is moved to step 5 the system automatically assumes that the order is ready to be shipped. Some boutiques have daily pickups (the courier passes through the store every day, at a predetermined time) while the others must schedule the pickup in advance according to the expected number of orders. The order is moved to the next step (parcel in transit) once the courier scans the AWB. When the parcel is scanned, an automatic email is sent to the customer, informing them that their order has been shipped. This way, Farfetch creates the distinction in the customer's conscience of how long the company took to process the order and how long took the courier company.

## 3.3 Key Performance Indicators (KPI)

In order to evaluate process performance there are some key performance indicators (KPI) used by the company. The most important KPI to the operations supply team are the ones directly related to the stores performance. These are No Stock and Speed of Sending. There is also another important KPI, Net Promoter Score (NPS), which is common to the whole company. Internal goals are established for each KPI on a monthly basis according to different criteria.

These KPI are further explained below.

### 3.3.1 No Stock

As mentioned before, it is possible that a physical sale is made in the boutique after an order for that item is placed, creating a no stock situation. This is one of the worst customer experiences possible. The customer has already paid for the item and is expecting for it to be delivered in a few days. It also represents a lost sale. This metric measures the % of orders that were not fulfilled because they had a no stock. It is mathematically represented in equation 3.1, as seen below.

$$No\ Stock\ = \frac{NS}{Total\ orders} \tag{3.1}$$

Where:

NS – the orders that had a no stock during the period;

Total orders – all the orders that entered the system during the period.

The goals for this KPI vary according to how further into the season the month is. For example, February, which marks the beginning of a season, has a lower goal than June, which is almost at the end of the season. The reason for this is that there is more product available at the beginning of the season than at the end.

### 3.3.2 Speed of Sending

Speed of Sending is a KPI that measures the time elapsed between the moment the order was created and the moment it was picked up by the courier.

Currently it can be measured in two different ways, called Speed of Sending Gross and Speed of Sending Net. The first one measures the difference between the date the order was created and the date the order was sent. Speed of sending gross is mathematically expressed as in equation 3.2.

$$Speed\ of\ Sending\ Gross = OS - OC \tag{3.2}$$

Where:

OS – the time and date in which the order was sent by the boutique

OC – the time and date in which the order entered the system

The boutiques have some operational limitations. They usually have a limited working schedule (mainly working from Monday to Saturday). Also, there can only be pickups during the week. This way, speed of sending gross could lead to wrong conclusions when evaluating a boutique's performance, as they don't take into account these limitations. For example, if an order is created at 7pm on a Monday and it is sent on the next Wednesday at 7pm, the Speed of Sending Gross will be 2 days. If another order is created at 7pm on a Friday and the boutique takes exactly the same time to process it, the Speed of Sending Gross will be 4 days.

To deal with this problem, Speed of Sending Net was developed. This KPI can be mathematically expressed as Time Spent on Steps 1, 3 and 5 minus Weekends, Holidays and time spent on hold. An order is placed on hold when something which halts order processing and isn't boutique's responsibility happens.

This way, only the time directly related to the boutique is measured. Speed of Sending Net is expressed as in equation 3.3.

$$Speed\ of\ Sending\ Net = T1 + T3 + T5 - Weekends - Holidays - Time\ Spent\ on\ Hold \tag{3.3}$$

Where:

T1 – the time that an order remained on step 1;

T3 – the time that an order remained on step 3;

T5 – the time that an order remained on step 5;

Weekends – the time that an order could not be processed because of the weekend;

Holidays – the time that an order could not be processed because of bank holidays;

Time spent on hold – the time that an order spent on hold

This KPI is the best way to measure the boutique's performance since it truly evaluates how long it took them to process an order. The most common way to present this KPI is as % of Orders Sent in Less than two days, as seen on the equation below, the service level agreement speed of sending net (SLA SOS). Internal speed of sending targets are established this way. Still it is not a truly proactive measure. SLA SOS is expressed as in equation 3.4.

$$SLA\ SoS = \frac{\sum Orders\ with\ Speed\ of\ Sending < 2\ days}{\sum Sent\ Orders} \quad (3.4)$$

Where:

Orders with speed of sending < 2 days – number of orders that were sent with a speed of sending net below 2 days, during the period;

Sent Orders – total number of shipped orders during the period.

Speed of sending goals are established according to the expected number of boutique orders. In fashion, demand must be analysed according to season. There are 2 seasons: the Autumn Winter (AW) season that starts in August and ends in January and the Spring Summer (SS) season that starts in February and ends in July. The demand is usually low at the beginning of the season, increases and stabilizes in the next months. It usually peaks at the end of the season in the sales period, when stores cut their prices trying to sell the items they still have in stock. Companies that operate globally usually have two peak periods each season, since the sales period in Europe starts a few weeks later than in the rest of the world. The pattern for Farfetch sales during SS14 and AW14 can be seen on Figure 5.

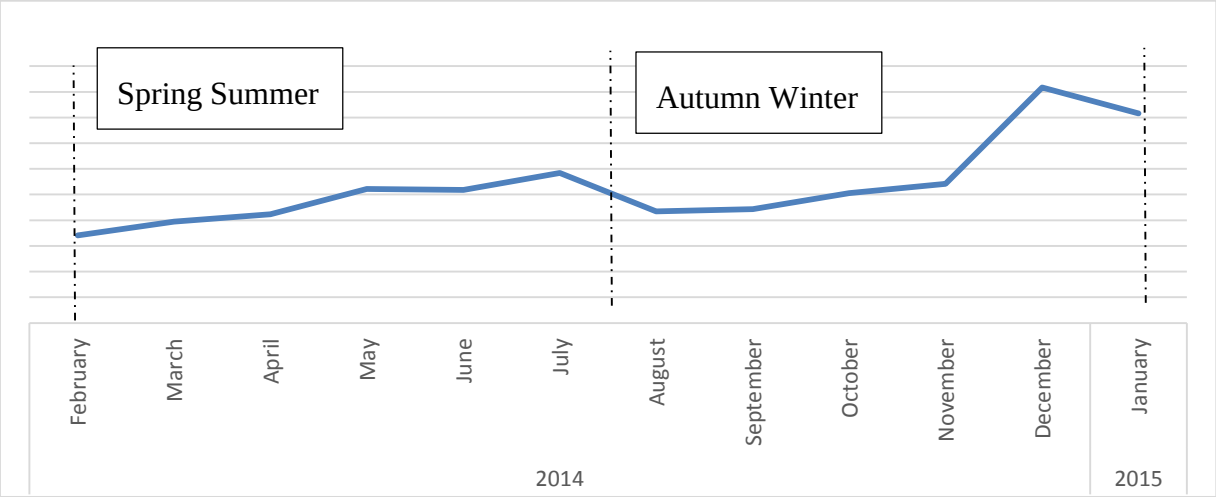



Figure 5 – Sales evolution between February 2014 and January 2015

This way the SLA SOS are usually higher at the beginning of the season and are then lowered until the sales period is over.

### 3.3.3 Net Promoter Score

When an order is delivered the customer automatically receives an email with a few questions related to its purchase, where the client can evaluate 5 different parameters, as seen in Figure 6.


Figure 6 - NPS form

The fourth and fifth questions are used to determine the boutique's and Farfetch's Net Promoter Score (NPS). The customer's answer may vary between 0 (not likely at all) and 10 (extremely likely). The answers are grouped in 3 different groups:

- Between 0 and 6 - Detractor;
- Between 7 and 8 - Passive;
- Between 9 and 10 - Promoter;

It is assumed that Detractors won't purchase again and will negatively influence Farfetch's image through word of mouth. On the other hand, Promoters will repurchase and recommend Farfetch's services to family and friends. NPS is measured as the difference between the percentage of Promoters and the percentage of Detractors. NPS is expressed mathematically as in equation 3.5.

$$NPS = P - D \tag{3.5}$$

Where:

P – The percentage of orders with a NPS score between 9 and 10;

D – The percentage of orders with a NPS score between 0 and 6.

## 3.4 Service 2.0

In September 2014 Farfetch introduced the Service 2.0 project in order to take "customer experience to the next level". Among other things, it aims at aligning the boutique's operations with Farfetch's and making order processing faster. Since Farfetch's steps are almost always

automatic, this can only be done by the boutique. To promote better speed of sending results, a policy of incentives and penalties was introduced. These are based on the boutique's speed of sending performance. The values can be seen in Table 1.

| ***Metric*** | |
|---|---|
| *Speed of Sending < 1 day* | Free Box (~1,5€) |
| *1 < Speed of Sending < 2,5 days* | No action |
| *Speed of Sending > 2,5 days* | The boutique pays the customer's shipping (~20€) |

Table 1 – Service 2.0 incentives/penalties

Although internal targets are established as "% of orders sent in less than 2 days" boutiques are only penalized if they fail to ship the order in less than 2,5 days. This might lead to misalignments between Farfetch objectives and boutiques objectives. Still, boutiques want to ship their orders as soon as possible, to receive the free box incentive.

As one can see from Figure 7, after the introduction of Service 2.0 Speed of Sending increased to values above 95%. This showed that stores were still able to achieve better results. In December there was an intense period of marketing campaigns. This lead to a sudden increase in the number of orders (monthly increase of 77% when compared to November 2014). Most of the boutiques weren't able to maintain their service levels. SLA speed of sending fell to approximately 75% and service 2.0 incentives/penalizations policy was shut down until the middle of January. The evolution of the results can be seen on Figure 7.

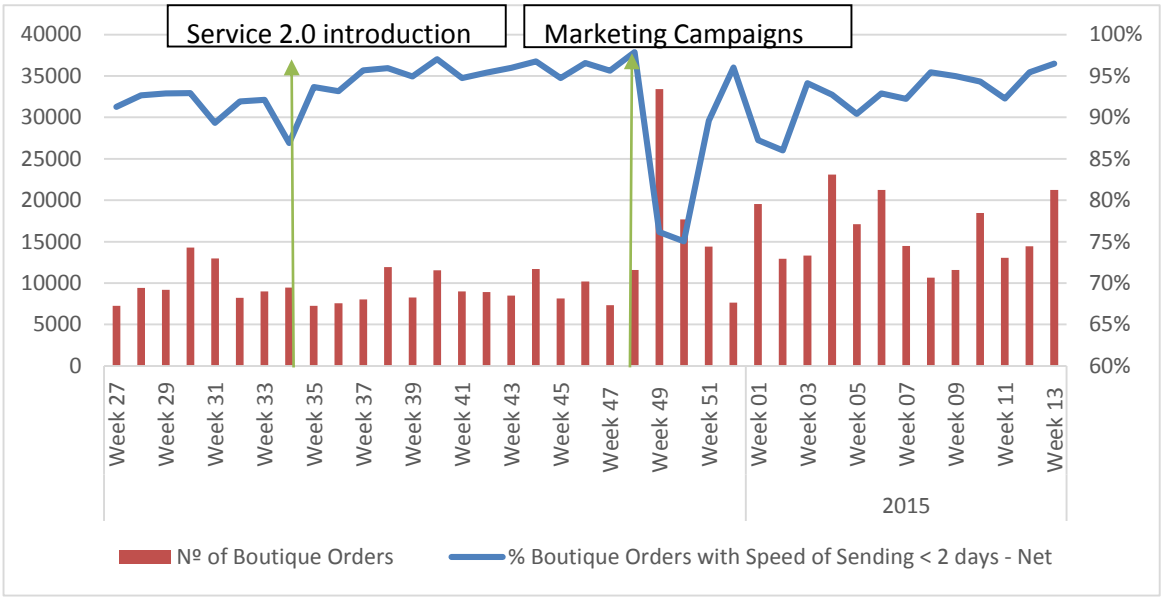



Figure 7 – Sales and Speed of Sending evolution

Given Farfetch's constant organic growth it is expected that the sales volume of the last weeks of 2014 becomes the average volume of sales during 2015.These results prove that boutiques are reaching their saturation point and must adapt their setups in order to keep an acceptable service level.

## 3.5 Boutique's Setup

A boutique setup is the aggregate of all the boutique's operational characteristics. Some of them can be changed and adapted easily while others may not. There are several different variables that define a boutique's setup. These can be related to:

- sales volume;

- human resources;
- boutique's dimension;
- number of stores the boutique operates.

Every boutique is a special case as it has different operational and geographical restrictions. These different store conditions make process standardization more complex and the development of decision support tools must consider all variables.

Currently, boutique setups are developed by the account managers and partner services in collaboration with the operations supply team. The strategy is usually based on past boutique behaviour and know-how from previous experiences. This method doesn't always work well given the impossibility to emulate working setups in similar boutiques. For example, a boutique might have limited pickup hours because of its geographical location.

To collect data and store it, there is a form with standardized questions that was used from April 2014 to July 2014. In there account managers and partner services filled important operational information from the boutiques, namely related to human resources and how the boutique handles order processing. Currently this form's questions are no longer the most pertinent. Nevertheless the collected information is still valuable to study past boutique behaviour according to employed resources.

During this dissertation, whenever there was the need to define the general behaviour of boutiques, only boutiques within the top 60 were analysed. This was decided because these boutiques account for approximately 74% of the sales. Figure 8 shows the relation between the number of boutiques and the number of orders.

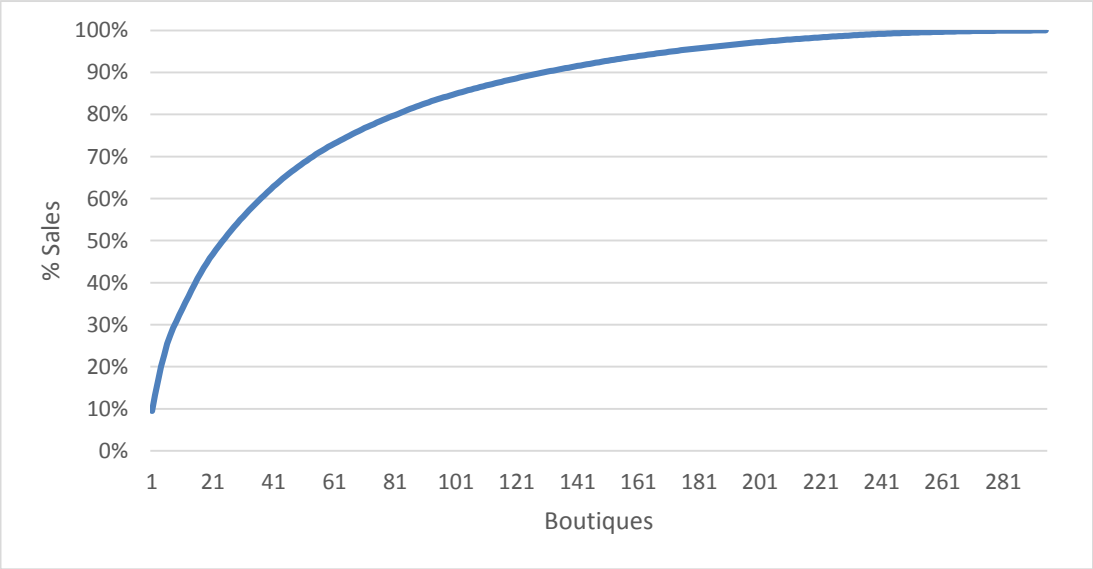



Figure 8 – Cumulative % of sales related to the number of boutiques

The boutiques are currently divided into 4 different types, according to 2 different variables. These are the number of independent stores they operate and how many pickup points they have. A pickup point is the place where the orders are shipped. The boutique types are called:

- All in One;
- Centralized;
- Decentralized
- Hybrid.

There are representatives of each boutique type in the top 60, except the hybrid type. The distribution in terms of percentage of the top 60 boutiques, according to boutique type can be seen below on Figure 9.


Figure 9 - Top 60 boutique type distribution

As it can be seen, the three boutique types are evenly distributed among the top 60. Each boutique type is further described below.

### All in One

All in One boutiques only operate one store and only have one shipping point. The store (i.e. physical space where physical sales occur), the warehouse and the office are usually located in the same building. There are some cases where the boutique has an independent warehouse near the store.

These are usually boutiques that have been in the market for only a few years and haven't still expanded. Still, there are some examples of all in one boutiques with a very large sales volume.

### Centralized

Centralized boutiques operate various stores but ship all the orders from the same space. The shipping point can be a central warehouse, where all the orders are processed, or the biggest store operated by the boutique or even an independent office where no "real" sales occur.

In most of the cases the stores are located in the same city, within a few kilometres radius. Still, there are some cases where the different stores are some hours apart but still ship orders from the same spot.

One of the most defining and important settings of a centralized boutique setup is in which step the items centralization occurs (i.e. when the items are gathered in the shipping point). There is no predefined or advisable step in the order processing in which the centralization should occur. Each boutique should decide it according to how their order processing is organized. Usually, boutiques centralize their items after checking that they have stock to fulfil the orders. The boutique online manager – the person in the boutique responsible for management of the Farfetch channel – contacts the various stores throughout the day telling what items are needed and the stores' clerks gather the items. Then an internal courier comes to the store and takes the items to the point where they'll be shipped. There the needed documentation is printed and the items packed.

### Decentralized

Decentralized boutiques operate various stores and each processes and ships its own orders. It's the most usual type for boutiques that operate stores in different cities or countries. If a customer orders several items from the same boutique, they only pay one shipping fee. This means that there will only be an AWB and that all the items must be shipped together. When this happens, and if the items are in different stores, the boutique must centralize the orders in one point before shipping it.

### Hybrid

A Hybrid is a boutique that operates several stores but only ships orders from some of them. The other stores ship their orders from centralized shipping points. This type of boutique is a mix between the decentralized and the centralized boutique type. It's the most unusual type of boutique setup and there is no boutique within Farfetch's top 60 with this boutique type.

## 3.6 Conclusions

Boutiques play a key role on Farfetch's success. Even if Farfetch achieves perfect performance on its processes, the company can fail to deliver an excellent service level if the boutiques don't perform accordingly. December's results proved that the boutiques were nearing their order processing capacity with the increased sales volume. It is essential that Speed of Sending values remain high, since they have a direct relationship with NPS and the repurchase rate as sustained by the data represented on Table 2.

| ***Speed of Sending net*** | ***0 to 2 days*** | ***2 to 3 days*** | ***3 to 4 days*** | ***4 to 5 days*** | ***>5 days*** |
|---|---|---|---|---|---|
| ***NPS*** | 87% | 82% | 77% | 63% | 52% |
| ***Repurchase Rate*** | 27% | 26,3% | 25,7% | 23% | 20% |

Table 2 – Relation between the Speed of Sending, NPS and Repurchase Rate

Farfetch, discovered a good way to improve sales and wants to explore the dynamics of promotions without compromising their service level. Boutiques must adapt their setups to face future seasonal peaks. Therefore it is essential that the boutique performance is analysed and new capacity measurement tools are developed. With these and combining them with forecast data, proactive actions may be taken and service levels assured throughout peak periods.

# 4 Developed solutions

## 4.1 Boutique Capacity Measurement Method

The first part of this project consisted in the development of a method that helps assess the maximum amount of orders that a boutique is able to send. This method should be applicable to every boutique and integrated in a tool usable by everyone inside the company.

### 4.1.1 Process analysis and data gathering

The order processing capacity of each boutique is the conjugation of several variables, such as personnel, number of stores, available space and more. One of the possible ways of solving this problem would be the identification and measurement of all these variables, for each boutique. Evaluating all this information for all partner boutiques is not possible, as they are independent and are willing to share different levels of operational data. Also, some of these variables can only be measured *in loco* and visiting all these places would be impossible in such a short period of time, since there are more than 300 boutiques in over 25 countries. Since the developed method should be applicable to all the partner boutiques, it was decided that the method should be based on historical data, stored in Farfetch Databases (DB).

For the boutique, the order processing has 3 time consuming tasks: picking the item, packing the item and printing the needed documentation. An interesting approach would be analysing which of these tasks is the bottleneck of the process. To do that, it would be necessary to measure how much time the boutique takes to do these tasks. Farfetch only stores the date and the time on which each step was confirmed on the system. These data do not correspond directly to any of the mentioned above tasks. This way it is not possible with the available data to verify how much time each task took.

After a more careful analysis of the order processing and after talking to several AM and PS, it was possible to infer that the bottleneck of order processing is the packing. Printing the documents can be made for several orders at a single time. A similar thing happens with picking the item. The employee may go to the store and collect several items at the same time. Packing the item can only be done for a single item each time. Also, given the fact that the customer never deals physically with the boutique and Farfetch, the quality of the packing is vital to the service quality. This way, boutiques take special care when packing the item.

There are mainly two resources that affect the packing: employees and boxes. Given the limited space boxes occupy, those can and are stocked in large quantities by the boutiques. On the other hand, the boutique has a limited number of employees available. Although some boutiques have employees that only do Farfetch related tasks, there are still many boutiques with lower order volumes where the employers do both Farfetch related and Farfetch non-related tasks. This way, it can be assumed that only one resource restricts the order processing.

In a situation where there is only one resource limiting the processing capacity, it is expected that when the demand increases the production also increases. Once the production is working

on its full capacity it stops matching the demand and stabilizes, even if the demand keeps rising. Figure 10 demonstrates graphically a situation like this.

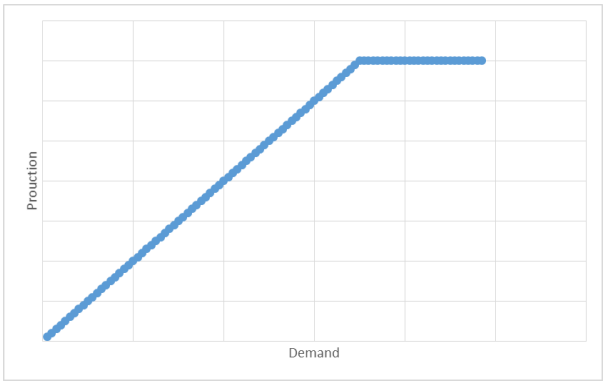



Figure 10 – Relation between the production and demand with 1 bottleneck

To test if a similar situation happens with the boutiques, a similar scatter graph was developed for 6 boutiques. To guarantee the significance of the sample, boutiques were chosen according to 2 different criteria: results and boutique type. One boutique of each type was chosen. It was assumed that a boutique had a good result if its SLA Speed of Sending was above 96% while it was bad if it was below 90%.

For privacy issues, the boutiques' real names won't be used. Instead, each boutique will have a letter associated. This information can be seen in Table 3.

| | ***Boutique Type*** | ***Result*** | ***SLA Speed of Sending*** |
|---|---|---|---|
| ***Boutique A*** | All in One | Good | 99,0% |
| ***Boutique B*** | All in One\ | Bad | 89,3% |
| ***Boutique C*** | Centralized | Good | 96,6% |
| ***Boutique D*** | Centralized | Bad | 85,64% |
| ***Boutique E*** | Decentralized | Good | 96,27% |
| ***Boutique F*** | Decentralized | Bad | 87,6% |

Table 3 – Boutiques used for testing results

In the y-axis it was used the number of orders sent by the boutique that day. The x-axis represents the number of orders on Pipeline. The Pipeline corresponds to all the orders that have been placed on that boutique and haven't still been sent. Each dot in the graph represents the Pipeline and the Number of orders sent in a given day. The data was sorted according to the pipeline from the lowest value to the highest value.

Packing the items is a manual job. The packing time differs according to the item category and characteristics. For example, an item of a delicate fabric requires a better and more robust packing than a regular pair of shoes. This means that the maximum quantity of orders a boutique can process each day varies according to the items they pack that day. This way, it is expected that the boutique's processing capacity is not constant. It slightly fluctuates.

In some of the graphs, it is possible to observe some outliers to the expected behaviour, namely on boutique B, boutique C and boutique F. For those boutiques, there are some days where a relatively big number of orders was sent, compared to what they usually send. These can be explained by the fact that some boutiques also work during the Weekend and during Bank Holidays. This is a common practice for Farfetch partner boutiques during periods of high demand. As there are no deliveries during those days, the extra orders that were processed are sent on the next day with delivery together with the orders processed in that day. Those data points reflect the work capacity of more than an ordinary day of work. The outliers that

corresponded to Mondays or the working day after a bank holiday were excluded from the graphs. The original graphs with the outliers can be consulted on Appendix A. The graphs without outliers can be seen below on Figure 11.

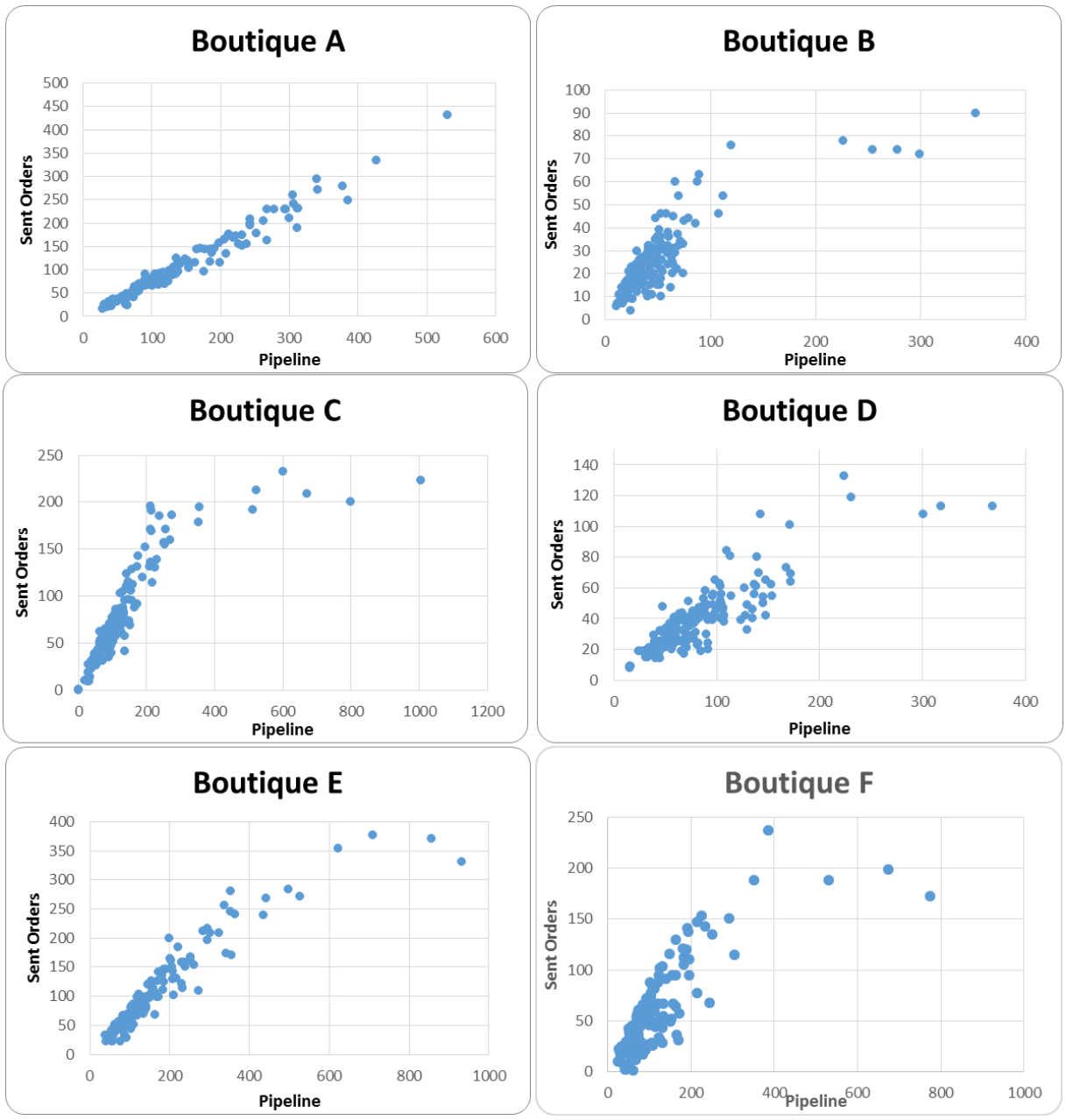



Figure 11 –Relation between the order on pipeline and the sent orders

Boutique B, C, D, E and F show the expected behaviour. It is clearly possible to observe that the number of sent orders stabilizes even though the number of orders on the pipeline keeps rising.

According to the characteristics of order processing of each boutique type, it is expected that decentralized stores show a different behaviour than their centralized and all in one counterparts. For both the centralized and all in one stores, the packaging is made in one place, with the same resources. In the decentralized stores, the packaging is made in different places and each place uses different resources. Thus it is logical that each pickup point has its own processing limit. This hypothesis is sustained by the graphs below on Figure 12. In these graphs, the data is presented by pickup point. Both boutique E and boutique F have 2 pickup points. These graphs are produced as if each pickup point was an independent boutique.

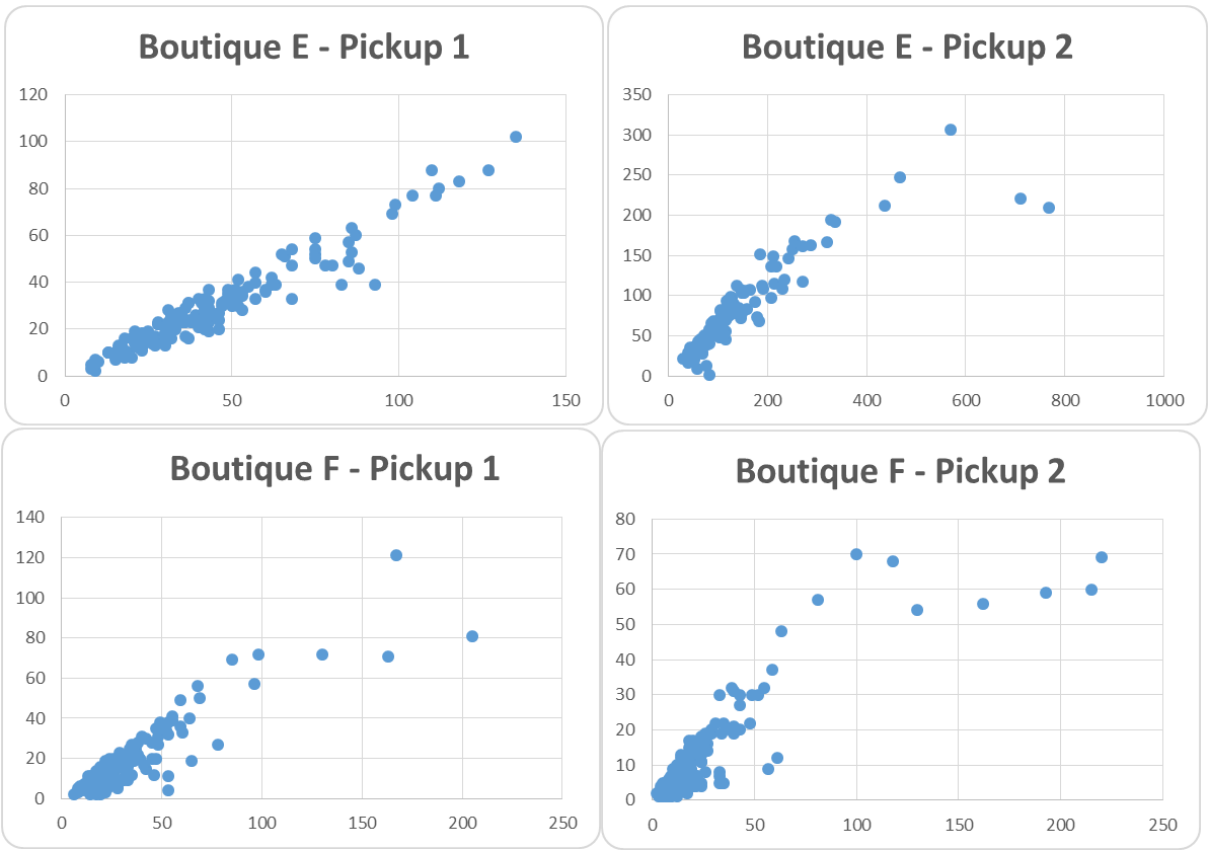



Figure 12 - Relation between the order on pipeline and the sent orders by pickup point

From the analysis of the graphs above, one can assume that decentralized boutiques must be analysed by pickup point.

Boutiques B, C, D, E (pickup point 2) and F show the expected behaviour, with a clear limit to the capacity of processing orders. In Boutique A and Boutique E (pickup point 1) it is only possible to observe a linear relationship between the pipeline and the number of orders sent. One possible explanation for this is that these boutiques have never been in a situation where their resources weren't enough for the demand they had. This is likely to happen in big boutiques that can easily assign extra employees from the shop floor to the packaging, whenever needed.

The boutiques can be divided into two different groups. The first corresponds to the boutiques that have reached the limit of their processing capacity on the past. Their processing capacity can be estimated using the relation between the pipeline and sent orders. The second group consists of boutiques that have never reached their maximum capacity in the past. Although it is not possible to infer their processing capacity using this method, it is possible to verify that up until some amount of orders they have no problem.

### 4.1.2 Method definition

After the various analysis described in 4.1.1, it was decided that the method would use the relationship between the number of orders on pipeline and the number of sent orders, to assess what is the maximum processing capacity of the boutiques. It will not require any data that is already not collected by the company and stored in its databases. Also, it will be possible to assess extra information that will be valuable to the boutiques.

For clarification reasons, there was the need to define a nomenclature system. The point/day where the boutique capacity starts to be fully used will be from now on called break point. The region that includes all the days in which the boutique is processing orders at its maximum capacity is called saturation phase. The week where more days are within the saturation phase,

is called the crisis week. In Figure 13 it is possible to observe the break point, by the red dot, and the saturation phase.

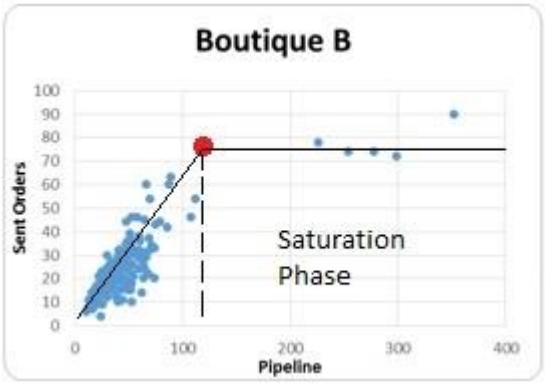



Figure 13 – Break point and saturation phase representation

As mentioned before, the developed method aims at assessing what is the processing capacity of a boutique. It can be summarized in the following 5 points:

1. Calculate the number of sent orders and the number of orders on pipeline for each day;
2. Sort the values from the lowest number of orders on the pipeline to the highest;
3. Identify break point;
4. Calculate the sent orders average, beyond the break point;
5. Recalculate the sent orders average, without outliers.

Two pressure points in the method can be acknowledged: identifying the break point and identifying the outliers.

**Identifying the break point**

The periods with the highest demand are during the sales period, which happens at the end of each season. They are usually characterized by a big increase in orders in just one day. It is not uncommon that the number of boutique orders increase by more than 500% in the first day of sale. With the increase in the demand also the boutique's response increases, until the maximum capacity of the boutique is reached. When this happens, a disproportionate increase in the number of orders on pipeline occurs. After this stage, and while the boutique remains in this situation, the pipeline will increase while the number of sent orders remains constant.

To identify the break point, one must find where the pipeline starts to largely increase and the number of sent orders stabilizes.

**Identify and eliminate outliers**

The outliers are days where the quantity of orders sent is well above the processing limit of the store. Usually, these are days where the quantity of sent orders corresponds to more than one day of work. This usually happens when a boutique works on the weekend or during bank holidays. It might also happen when a boutique had an extra employee for a particular day or worked a significant number of extra hours.

As the goal of this method is assessing the processing capacity of the boutique, all the data considered should correspond to the same time frame. When a store works during the weekend, during bank holidays or a significant amount of extra hours, there is no information about how many extra hours the boutique spent processing orders. This means that the boutique, for example, could have worked an extra morning, an extra afternoon or just a couple of extra hours. So, the quantity of extra sent orders on the days that correspond to the outliers, comes from an unspecified quantity of extra hours. Since there is no data available, it is not possible to treat the outliers and convert them into the same time frame as the other days. This way, all

the possible outliers that might affect the outcome of the method must be analysed and, if proven an outlier, eliminated.

The number of sent orders varies during the week, mainly because the number of orders that enter the system, also varies. This means that, for example, the same quantity of sent orders can be an outlier on a Wednesday but not an outlier on a Monday. Therefore, to identify if in a day an abnormally large number of orders was processed, there was the need to take this into consideration.

To see how much the weekday impacts the number of sent orders, the percentage of sent orders on each weekday, for the top 60 boutiques, was analysed for 3 months. The results can be consulted below on Table 4.

| ***Weekday*** | ***February 2015*** | ***March 2015*** | ***April 2015*** |
|---|---|---|---|
| Monday | 30% | 29% | 20% |
| Tuesday | 21% | 22% | 23% |
| Wednesday | 18% | 18% | 23% |
| Thursday | 15% | 15% | 20% |
| Friday | 15% | 16% | 13% |
| Saturday | 0% | 1% | 1% |

Table 4 – Sent orders distribution by weekday

No visible differences can be observed when comparing February and March. Yet, on April, the % of sent orders on a Monday and on a Friday fall. This can be explained by the fact that April had two bank holidays - Easter Friday and Easter Monday. Six out of the top 10 Farfetch markets on the supply side - which account for 74% of the sales volume - had no deliveries on Easter Monday. The remaining 4 countries of the top 10 - which account for 20% - had no deliveries during Easter Friday. This way, April was not considered for any calculations.

There are orders sent on Saturdays because Farfetch has partner boutiques in some Asian countries, where the weekend is on Sunday and Monday. Since the percentage of sent orders on a Saturday is almost nonexistent, it is considered that a Saturday should be considered like a Friday.

If no weekly trend existed, each day should account for 20% of the sent orders (again, Saturday is not counted as it represents a minimal percentage of the orders). To calculate how much more orders are expected to be sent each weekday, the percentual difference between the expected (20%) and the real number of sent orders is calculated. These can be consulted below on Table 5.

| ***Weekday*** | ***Used*** |
|---|---|
| Monday | 47% |
| Tuesday | 7% |
| Wednesday | -10% |
| Thursday | -25% |
| Friday | -22% |
| Saturday | -22% |

Table 5 – Used relation

Using the data calculated above it is possible to assess if a boutique worked during a bank holiday.

### 4.1.3 Tool integration

One of the requirements for this method is that it should be usable by everyone in the company. Microsoft Excel® is used throughout Farfetch and allows the direct integration of data from the DB through a SQL query. Also, automated procedures can be coded via Macros, using the programming language Visual Basic for Applications (VBA). Because of the above mentioned capabilities and advantages within the company, the method was integrated in a Microsoft Excel Workbook.

The workbook contains 2 base worksheets, called "Data" and "Template". The first worksheet contains the data table directly connected to the DB. The Template worksheet can be seen in Figure 14.

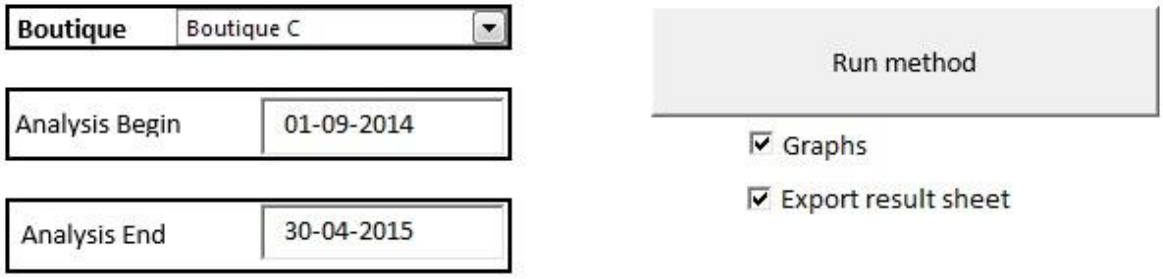



Figure 14 – Template worksheet

The macro associated with the "Run Method" button requires some information by the user, namely the period the analysis should cover. This is useful because one might only want to analyse a certain period, if he knows that a boutique only had problems sending their orders in a determined date or if he knows that the boutique changed its setup and wants to analyse its behaviour after the change. The predefined date corresponds to 01/09/2014 since it was when service 2.0 was initiated. The worksheet also has 2 checkboxes where one can choose other forms of presentation and documentation of the results. The extras that can be chosen are a sheet with detailed graphs about the store and the possibility of exporting the result sheet.

When the method is run, a "Result" worksheet is generated. An example of the "Result" worksheet is portrayed on Figure 15.

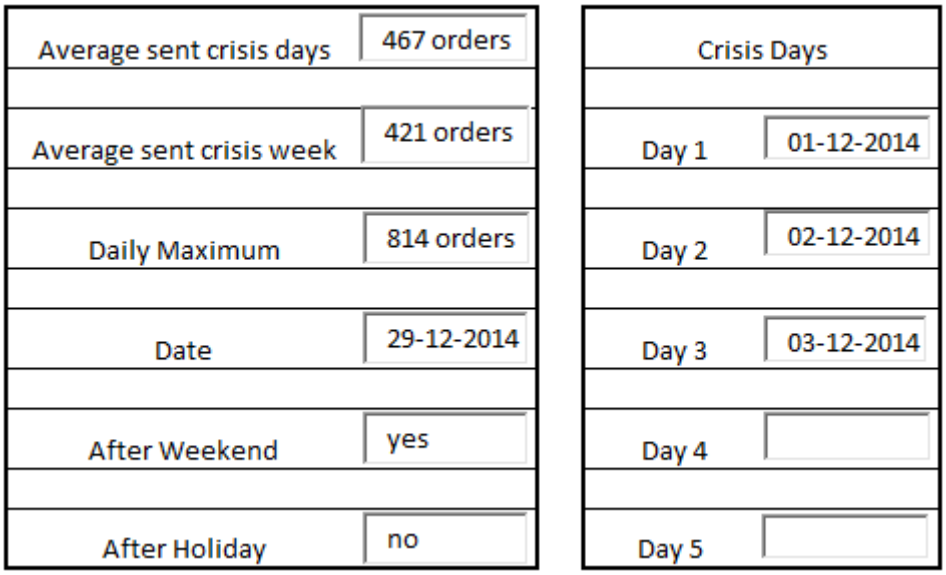



Figure 15 – Result worksheet

Other than the order processing capacity, two extra aspects are calculated: the maximum quantity of orders ever sent and when was the crisis week. The crisis week is the week where most days in a row are in the saturation phase. This concept was introduced for accuracy purposes. When the boutique works at its maximum capacity for several days, it is expectable that its human resources start to get tired and process less orders. Having that in mind, only the days of the crisis week are taken into account, when calculating the boutique's performance capacity. In the results sheet, the days of the crisis week are included. This way, one can connect the dates of the crisis days with the specific promotions that happened.

The day when the boutique sent the maximum quantity of orders is also shown, as well as if it was after a holiday or a weekend. The last information is calculated since it is interesting for the boutiques. With this information, they can associate that to how many extra hours and how many extra employees they had working when that result was achieved.

The "Graphs" worksheet has 3 different possible graphs: the graph similar to the ones on Figure 11 for the boutique; the same graph but with only the days in the saturation phase represented; and the evolution of the pipeline, the number of sent orders and the processing capacity, during the crisis week.

According to the boutique's situation, only some of the graphs might be available. For example, if a boutique has never reached its maximum processing capacity, only the relation between the pipeline and sent orders will be shown.

An example of the Graphs present in the worksheet can be seen in Appendix B.

### 4.1.4 Method Coding

In this section, the most important parts of the code are explained, including the procedure used for each.

**SQL query development**

The first part of the coding consisted on the development of the SQL query that would retrieve the needed data from the DB. The SQL query was adapted during the coding, so it would have everything that was needed. The query retrieves the following data/columns:

- Boutique Order – internal id each order has;
- Created date and time – date (dd-mm-yyyy format) and time (hh:mm:ss format) in which the order entered the system;
- Send date and time – date (dd-mm-yyyy format) and time (hh:mm:ss format) in which the order was picked up by the courier;
- Speed of sending net

The SQL query can be consulted in Appendix C.

**Calculating the pipeline and the pickup time**

For accuracy purposes, the pipeline used only consists on the number of orders on the system before the pickup hour. It would have not made sense if the orders that entered the system after the pickup hour were counted, since the boutique would have not been able to process these orders that day.

Since the Pickup time is not the same every day – for reasons external to Farfetch and the partner boutique – there is the need to calculate the pickup time for each day. Also, in days with a big number of orders, some boutiques request a double pickup by the courier company. This means that the courier company will go to the boutique twice, once in the morning and another time in the afternoon. Although the delivery courier must scan every order on site, when it is picked up, this action is prone to failure. When this happens, the order is only scanned in the

courier warehouse, usually a few hours later. On Figure 16 it is possible to see the distribution of the percentage of sent orders in an example day, where the pickup hour was at 4pm. As it is possible to see, a small percentage of orders was only scanned at 9pm, when the boutique was already closed. This means that it was scanned at the warehouse and not at the boutique.

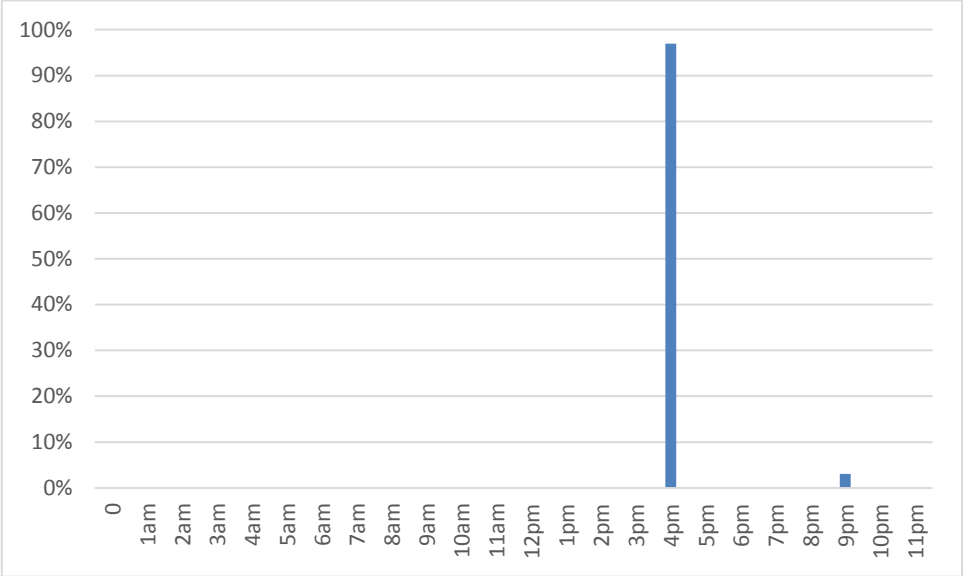



Figure 16 - Percentage of orders sent by hour

If the delivery courier scanned every order on site, the pickup hour would be considered the hour when the last order was scanned. Since this does not happen, another form of calculating was developed. Given the fact that no orders can be shipped between 20pm and 7am (the boutiques are closed) the percentage of orders sent within this range are orders that were only scanned in the warehouse. From January to March, 4,46% of the orders were scanned within the mentioned time frame. Therefore, it was defined that the pickup hour would be considered to be the last hour where at least 10% of the orders sent that day were shipped. That percentage was chosen because it represented a significant percentage of orders and excluded the orders that were not scanned on site.

The VBA code for this procedure can be seen in Figure 17.

```
Sub Pickup(ByRef aHour() As Integer, ByVal nOrders As Integer, ByRef PickupHour As Integer)

    For i = 0 To 23
        If (aHour(24 - i) / nOrders) > (1 / 10) Then
            PickupHour = i + 1
            i = 23
        End If
    Next

End Sub
```

Figure 17 - Pickup hour calculation procedure

### Calculating the break point

As mentioned before, to define the break point one must find where the pipeline starts to largely increase and the number of sent orders stabilizes. As the number of sent orders slightly varies within the saturation phase, there was the need to define up until which variation in the sent orders is acceptable. Also, when the boutique reaches the saturation phase, there is a disproportionate increase in the pipeline. Therefore, there was also the need to identify from which increase in the pipeline a point would be considered the break point.

To define the values used for these variations, the processing capacity for 8 boutiques was calculated manually. Then, 5 different combinations of values for the allowed pipeline variation

and for the variation in the number of sent orders were calculated. The one that best identified the break point in most situations was the variation of 20% in the pipeline and 10% in the number of sent orders, which is the combination used.

To define which is the break point, the following procedure was defined:

1. Sort the number of orders on Pipeline in descending order;
2. Loop through every value, starting in the day with the highest pipeline;
3. If the pipeline of the next day in the series (of descending pipeline) is at least 20% inferior to the pipeline of the analysed day and the difference in the number of sent orders is less than 10%, this point is defined as the break point. Stop the procedure when this point is found;

The VBA code for this procedure can be seen below on Figure 18.

```
Sub BreakPoint(ByVal rngPipeline As Range, ByVal nDays As Integer, ByRef nBreakPoint As Integer, ByRef nCounter As Integer)

    Dim dPipDif As Double 'pipeline percentual difference
    Dim dSenDif As Double 'sent orders percentual difference

    Call orderPipeline(rngPipeline, nDays)

    nBreakPoint = 0

    For i = 1 To norders - 1
        dPipDif = rngPipeline(norders - i, 1) - rngPipeline(norders - i - 1, 1)
        dSenDif = rngPipeline(norders - i, 2) - rngPipeline(norders - i - 1, 2)

        If dPipDif < (-2 / 10) And dSenDif > (-1 / 10) And dsenddif < (1 / 10) Then
            nBreakPoint = norders - 1
            nCounter = i
            i = norders - 1
        End If

    Next


End Sub
```

Figure 18 - Identifying the break point procedure

For accuracy purposes it was decided that a boutique must have at least 3 points in the saturation phase. Assessing that the number of sent orders stabilized with only 2 values will probably lead into concluding that a boutique has reached its maximum order processing capacity when it has not.

After the break point calculation 3 possible situations might happen:

- If there are at least 3 points within the saturation phase, the tool continues normally;
- If there are 2 or less points within the saturation phase, the tool returns a message. The message says that the data is not conclusive enough and, therefore, the processing capacity can't be accurately calculated. It also says that the boutique might have never been in a situation where their resources are fully used. Still, the number and the day where the maximum number of orders was sent is calculated shown at the Results worksheet;
- If there is no break point the program returns a message saying that the store has never been in a situation where its resources were being used at its maximum capacity. Still, the maximum number of orders ever sent is calculated and shown at the Results worksheet.

### Identify and eliminate the outliers

To identify the outliers, the following procedure was used:

1. Identify the weekday of every day inside the saturation phase;
2. Calculate the average of sent orders inside the saturation phase;
3. For every day above the saturation phase, assess if the number of sent orders is above the outlier limit – explained below. If it's above the outlier limit and it is a Monday or the day after a bank holiday, eliminate it.
4. If an outlier was found, redo step 2 and 3.

The outlier limit is the value from which, if more orders are sent, the day analysed is considered an outlier. Therefore, the outlier limit should be calculated as the expected number of sent orders for a normal day, incremented by the increase expect of the extra work. It is assumed that a boutique will work at least half a day, when working during the weekend or during a bank holiday. Thus, the expected number of sent orders is multiplied by a factor of 1,5. The outlier limit is calculated as shown below on the following equation:

$$Outlier\ limit = Avg * (1 + wf) * 1{,}5 \tag{4.1}$$

Where:

Avg – average of sent orders within the saturation phase;

Wf – weekday factor.

Point 2 is redone if an outlier is found, in order to adjust the average of sent orders. All the points above the saturation phase are analysed again, as the outlier limit shrunk.

If, after eliminating the outliers, there are less than 2 points within the saturation phase, the method stops and returns a message saying that the results are inconclusive with this data and that the processing capacity can't be accurately calculated.

The code for this part can be seen below in Figure 19.

```
Sub EliminateOutliers(ByRef rngPipeline As Range, ByRef nDays As Integer, ByVal nBreakPoint As Integer, ByVal dAvg As Double)

    Dim aWeekday(nDays) As Integer
    Dim aOutWeek(6) As Double
    Dim aux As Integer
    Dim dAvg As Double
    Dim bBankHoliday As Boolean

    For i = nBreakPoint To nDays
        aWeekday(i) = Application.WorksheetFunction.Weekday(rngPipeline(i, 3), 2)
        dAvg = dAvg + rngPipeline(i, 2)
    Next

    aOutWeek(1) = (47 / 100)
    aOutWeek(2) = (7 / 100)
    aOutWeek(3) = (-1 / 10)
    aOutWeek(4) = (-25 / 100)
    aOutWeek(5) = (-22 / 100)
    aOutWeek(6) = aOutWeek(5)

    dAvg = dAvg / (nDays - nBreakPoint)

    For i = nBreakPoint To nDays
        bBankHoliday = False
        If dAvg * aoutweekday(aWeekday(i)) * (15 / 10) < rngPipeline(i, 2) Then
           Call BankHoliday(bBankHoliday, rngPipeline(i, 3))
           If bBankHoliday = True Then
                For j = 1 To nDays - 1
                    rngPipeline(j, 2) = rngPipeline(j + 1, 2)
                Next
                nDays = nDays - 1
                For j = i To nDays
                    dAvg = dAvg + rngPipeline(j, 2)
                Next
                dAvg = dAvg / nDays
                i = nBreakPoint
            End If
        End If
    Next

End Sub
```

Figure 19 – Outliers identification and elimination procedure

## 4.2 Boutique Capacity Needs

The second part of this project consisted in the development of a tool that would assess how many orders the boutiques should be able to send, to meet the Speed of Sending targets. This is based on the demand forecasts that the user must insert into the tool.

As with the method before, this tool should be applicable to every boutique and be usable by everyone in Farfetch.

### 4.2.1 Procedure

The procedure uses as inputs:

- The forecasts in terms of orders per day;
- The start and end date of the period;
- The estimated processing capacity of the boutique;
- The speed of sending target for that period;
- The boutique pickup hour.

The result is the required processing capacity, in terms of orders processed daily – the needed processing capacity. The procedure can be summarized in the following 6 phases:

1. Define which days have no deliveries;
2. Create orders, according to the forecast;
3. Define up until which time each order must be sent – the must send date;
4. For each day and according to the boutique performance capacity, calculate how many orders are sent each day and how many are sent outside the target;
5. Calculate the Speed of Sending for each day;
6. If the target is not met, increase the processing capacity by 50 orders and redo phase 4 and phase 5 until the target is met;

The most critical phases of the above mentioned procedure are phase 2, phase 3 and phase 4, which are further explained below

**Phase 2**

During this phase, the procedure creates fictional orders according to the inputted forecasts by the user. Each order is attributed a code number, the day it entered the system - order date - and the hour it entered the system - order time. As the company's internal targets are set in SLA speed of sending (% of orders sent with a speed of sending net below 2 days), defining the hour that an order enters the system is fundamental for the correct definition of the boutique's needed processing capacity.

To define how this should be assigned to the orders, the hourly distribution of new orders from January to April was analysed. It showed that there are no considerable variations in the distribution. This behaviour was expected since during the period, the geographical distribution of the clients remained constant. Therefore, the hourly distribution was defined according to the average of the 4 mentioned months. The hours are expressed in the GMT time zone. The used distribution is presented below, in Table 6.

| *12am* | *1am* | *2am* | *3am* | *4am* | *5am* | *6am* | *7am* | *8am* | *9am* | *10am* | *11am* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3,43% | 3,48 % | 3,34 % | 3,61 % | 3,57 % | 3,37 % | 3,26% | 3,49 % | 3,81 % | 3,85 % | 3,96% | 3,96% |
| ***12pm*** | ***1pm*** | ***2pm*** | ***3pm*** | ***4pm*** | ***5pm*** | ***6pm*** | ***7pm*** | ***8pm*** | ***9pm*** | ***10pm*** | ***11pm*** |
| 4,12% | 4,60 % | 5,13 % | 5,45 % | 5,53 % | 5,18 % | 4,90% | 4,75 % | 4,51 % | 4,59 % | 4,23% | 3,85% |

Table 6 – Distribution of new orders hours

**Phase 3**

The must send date is the last day where an order can be sent with a Speed of sending net below 2 days. Theoretically, if the order creation weekday is on a Monday, Tuesday or Wednesday it needs to be sent two weekdays after. As the weekends are not taken into account, if it is on a Thursday or Friday it must be sent Monday and Tuesday respectively. Finally, if an order date weekday is a Saturday or a Sunday, it must be sent until Tuesday.

Given the fact that usually only one pickup occurs during each day, if the pickup hour is after the order time (the hour the order entered the system), the order will have a Speed of sending net above 2 days when sent. For example, if an order entered the system in a Tuesday at 4 am and the pickup hour is at 4pm, the order will have a Speed of sending net of 2,5 days if sent Thursday.

Therefore, the orders can be split into two distinct groups, according to the relation between the pickup hour and the order time. For this procedure, it is assumed that only one daily pickup occurs. This way, it is possible to determine up until which weekday an order must be sent, according to the weekday it was created. Table 7, shows in which weekday an order must be sent, according to the weekday it was created.

| | ***Must Send Weekday*** | |
|---|---|---|
| *Weekday Created* | *Order Time > Pickup Hour* | *Order Time < Pickup Hour* |
| Monday + Time | Wednesday | Tuesday |
| Tuesday + Time | Thursday | Wednesday |
| Wednesday + Time | Friday | Thursday |
| Thursday +Time | Monday | Friday |
| Friday + Time | Tuesday | Monday |
| Saturday + Time | Tuesday | Tuesday |
| Sunday + Time | Tuesday | Tuesday |

Table 7 – Must send weekday according to weekday and pickup hour

Another factor that affects the must send date are bank holidays. These are treated like a weekend day and aren't counted for the speed of sending net. If an order enters the system during a holiday its must send date will be two days after, no matter the order time.

**Phase 4**

During this phase the send date of the orders is defined. It is assumed that the boutique processes the orders using a first in first out (FIFO) logic. For each day, where orders can be sent, the pipeline before the pickup hour is calculated. If it is bigger than the processing capacity, it is assumed that the number of sent orders that day is equal to the processing capacity. If the pipeline is inferior, it is assumed that the number of sent orders is equal to the pipeline before the pickup hour.

After that, and also for each day with deliveries, the number of orders sent after the must send date is calculated. This number divided by the percentage of sent orders represents the % of orders sent with a speed of sending net of 2 days.

### 4.2.2 Tool integration

Microsoft excel was again chosen as the basis for this tool, since it allows procedure coding through Macros and is used by everyone in the company.

The method is integrated in a Microsoft Excel workbook. The workbook has 4 worksheets: "Template", "Boutiques", "Holidays" and "Hours". The template sheet is the only one accessible to the common user. In this worksheet, the user must provide some information, as can be seen below on Figure 20.

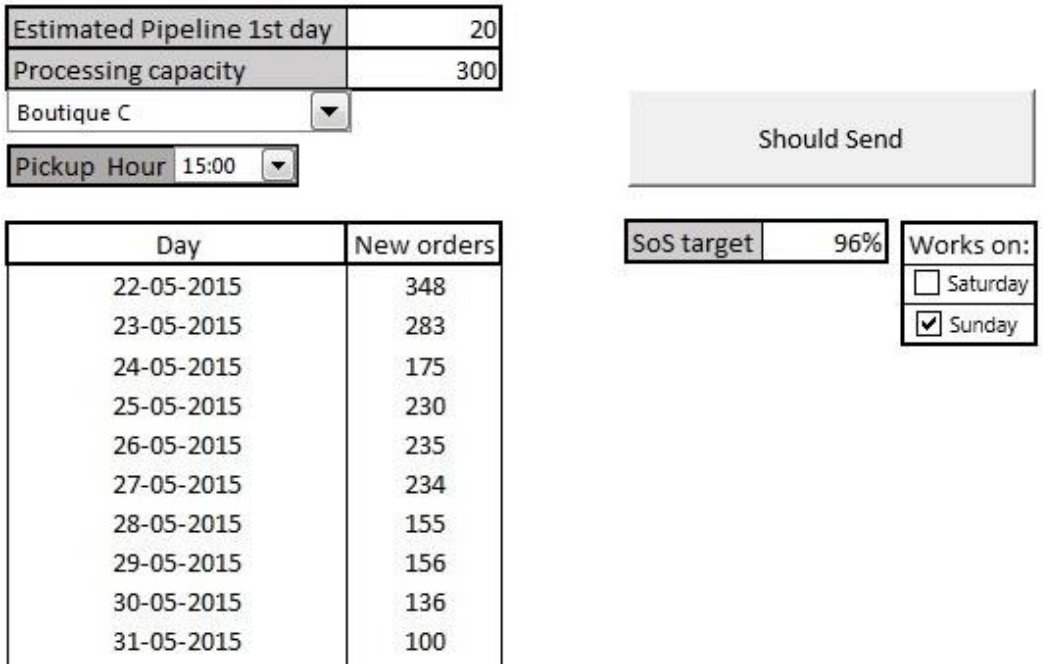



Figure 20 – Template worksheet

The "Estimated Pipeline 1st day" consists on how many orders are expected to be on the pipeline at the beginning of the first day of analysis. This value is important, since these orders will be processed and will use resources during the analysis period. The "Processing capacity" consists on how many orders the boutique is able to send with its current resources. This value should be calculated using the method developed above. If the method was unable to deliver a result, the day with most orders sent, that is not an outlier, should be used.

The first combo box holds a list with all of Farfetch's partner boutiques. This combo box is linked to the "Boutiques" worksheet. This worksheet stores the list of boutiques and in which country they are located. The country where the boutique is located is important, since each country has specific bank holidays where no deliveries are made. A list of all the bank holidays of all countries with Farfetch partner boutiques is available in the worksheet "Holidays". The "Hours" worksheet stores the information related to the percentual distribution of the orders, according to the hours of the day. In the second combo box the user must select which is the boutique pickup hour.

The user must provide the information on which days he wants the analysis to be made and how many new orders have been forecasted for that day. Only days with a forecast for new orders will be accepted. In the "SoS target", the user must input the Speed of sending target for the period in analysis.

Finally, the last required input is if the boutique will be working on Saturdays and Sundays. If the boutique only works one extra weekend day, it is assumed that their processing capacity doubles on Monday. If it works the full weekend, it is assumed that the processing capacity triples.

When the macro associated with the "Should Send" button is run, a message box appears saying what the needed processing capacity of the boutique is. Also, a worksheet named "Orders" is created. In it, there's a resume table for each iteration. In each table and for each day, there's the information of how many orders were created that day, how many orders were sent, how many orders were sent late and the speed of sending result. An example table can be seen on Table 8.

| Processing Capacity | 250 | | | | |
|---|---|---|---|---|---|
| Day | New Orders | Pipeline Before Pickup | Sent Orders | Sent late | Speed of Sending |
| 22-05-2015 | 530 | 20 | 250 | 0 | 1 |
| 23-05-2015 | 425 | 300 | No Deliveries | 0 | No Deliveries |
| 24-05-2015 | 250 | 725 | No Deliveries | 0 | No Deliveries |
| 25-05-2015 | 295 | 975 | 250 | 0 | 1 |
| 26-05-2015 | 301 | 1020 | 250 | 0 | 1 |
| 27-05-2015 | 234 | 1071 | 250 | 206 | 0,176 |
| 28-05-2015 | 201 | 1055 | 250 | 250 | 0 |
| 29-05-2015 | 185 | 1006 | 250 | 250 | 0 |
| 30-05-2015 | 175 | 941 | No Deliveries | 0 | No Deliveries |
| 31-05-2015 | 150 | 1116 | No Deliveries | 0 | No Deliveries |

Table 8 – Processed orders table example

The information on this table useful if one wants to do a more detailed analysis and send information to the boutique on how many orders they will have on Pipeline.

## 4.3 Boutique Score

The sales period is the most critical for boutiques performance. Yet, a store might also underperform during other periods. There are mainly two types of factors that can cause this: operational or promotional.

Operational factors are the ones related to the boutiques resources and order processing. For example, if an employee usually in charge of processing orders is on vacation it is expected that the boutique's performance decreases.

Promotional factors are the ones related to special marketing campaigns during the year. For example, usually once a month there is a promotional campaign called Free Shipping, where the customer does not pay any fees for the order shipping. During this period, boutiques' demand usually doubles.

It is also possible that stores underperform for no apparent reason.

Potential underperformance situations, primarily when caused by operational factors, are hard to predict. Currently, these are only detected once the boutique underperforms. Any action taken by then is usually late and the underperformance situation may continue for more days. To foresee future danger situations a new indicator, called Boutique Score, was developed. Its main requisite is that it should react hastily so corrective actions can be taken as soon as possible. Since performance is measured on a daily basis, this indicator should be designed so it can also be used on a daily basis.

### 4.3.1 Possible factors analysis

A boutique underperforms if it fails its speed of sending targets. To ultimately detect if a boutique is on the verge of underperforming, the new indicator should measure the factors that affect speed of sending. Those factors can be divided in two groups: setup factors and variable factors. The first are mostly related to the boutique structure and are hardly changeable. These evaluate if a boutique is prone to underperform. The second group of factors are related to day-to-day situations, and evaluate the current situation of the boutique.

On a first phase several possible factors were determined. They can be seen below on Figure 21.

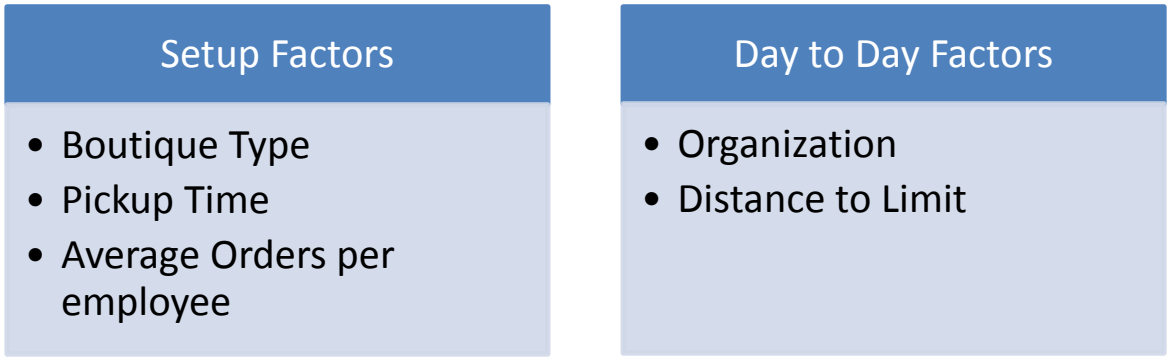



Figure 21 – Tested factors

Each factor was analysed and, if it was needed, it was tested. The top 60 boutiques in terms of orders were analysed for 3 different weeks. The weeks were chosen so they would represent different periods. The chosen weeks were:

- Normal week with no promotional campaigns - This week will be from now one referred to as NW;
- Week with a free shipping campaign - This week will be from now one referred to as FSW;
- Week after a free shipping campaign - This week will be from now one referred to as AFW;

To standardize the KPI, each factor was given a different weight according to its importance. The sum of all is 1. Within each factor, several scores are possible, according to the boutique's characteristics/performance. More on the definition of these scores is explained below.

#### Boutique type

Each boutique has its pros and cons. It is expected that some boutique types are more adequate to handle certain order volumes than others. For example, a centralized boutique is not expected to work well with a high order volume. This happens since all the items must be centralized before the packaging stage, which leaves the boutiques with less time to perform the most critical stages of order processing and effectively reduces their order processing capacity.

The obtained results organized by boutique type can be consulted on Table 9.

| ***Boutique Type*** | ***SLA SOS average week NW*** | ***SLA SOS average week FSW*** | ***SLA SOS average Week AFW*** |
|---|---|---|---|
| *All in one* | 95,95% | 96,75% | 94,80% |
| *Centralized* | 94,92% | 94,46% | 94,82% |
| *Decentralized* | 93,81% | 96,18% | 95,10% |
| *Average* | 94,90% | 95,80% | 94,91% |

Table 9 – Speed of sending results by boutique type

No considerable differences can be observed between the result of each boutique type and the performance average. Also, every boutique type delivers results above the average and below the average.

As mentioned before, the result should be related to the boutique type and the number of orders the boutique has. To test this, the boutiques were divided into order bands, according to how many orders the boutique had that week. The order bands were defined so each band would have approximately the same number of boutiques. A boutique might belong to an order band in a week and belong to another in the next week. The results obtained can be seen on Table 10.

| ***Boutique Type*** | ***Order Band*** | ***SLA SOS average week NW*** | ***SLA SOS average week FSW*** | ***SLA SOS average week AFW*** | ***All Weeks Average*** |
|---|---|---|---|---|---|
| *All in one* | 0 - 100 | 95,36% | 98,95% | 98,36% | 97,56% |
| | 100 - 150 | 96,21% | 97,79% | 96,34% | 96,78% |
| | 150 - 300 | 97,39% | 94,01% | 98,15% | 96,51% |
| | 300 - 1000 | 95,67% | 96,35% | 94,97% | 95,66% |
| *Centralized* | 0 - 100 | 94,91% | 93,78% | 92,80% | 93,83% |
| | 100 - 150 | 98,48% | 94,77% | 97,23% | 96,83% |
| | 150 - 300 | 94,80% | 95,77% | 93,95% | 94,84% |
| | 300 - 1000 | 94,22% | 92,71% | 94,67% | 93,87% |
| *Decentralized* | 0 - 100 | 91,77% | 95,25% | 94,74% | 93,92% |
| | 100 - 150 | 96,08% | 96,01% | 94,11% | 95,40% |
| | 150 - 300 | 98,25% | 97,54% | 96,11% | 97,30% |
| | 300 - 1000 | 97,74% | 96,75% | 98,51% | 97,67% |

Table 10 – Speed of sending results by boutique type and order band

A few conclusions might be drawn from the results analysis. All in one boutiques' performance decreases with the increase of orders. One possible explanation is that these boutiques are usually smaller and have fewer resources available than their decentralized or centralized counterparts. This means that these boutiques will have less space available to process orders and less manpower to allocate to the increasing number of orders.

Centralized boutiques don't perform well with small or large amounts of orders. Both these situations can be explained by the need to centralize the items. With a small amount of orders, there might not be enough quantity to centralize the items each day and that it might be costly to do so when compared to the generated revenue. With a large amount of orders, the boutiques will have less time to process the orders as they take time to centralize them.

Decentralized boutiques don't work well for low numbers of orders but are the boutique type that delivers the best results for high volumes of orders. When the number of orders is low, each store will have few orders to process daily. This means that the store's staff will probably not be very committed to Farfetch and its experience and knowledge on order processing won't be good. As mentioned before, decentralized boutiques must be analysed as a group of all in one boutiques. This means that a decentralized boutique with a high number of orders is, in fact, a group of all in one boutiques with a medium amount of orders. As seen before, this type of boutiques deals well with a medium number of orders.

The scores for the boutique type factor were decided according to the relations established between the boutique type and the order band. The decided scores for the boutique type can be seen on Table 11.

| ***Boutique Type/Order Band*** | ***0-100*** | ***100-150*** | ***150-300*** | ***300-1000*** |
|---|---|---|---|---|
| *All in One* | 0 | 0 | 0 | -0,5 |
| *Centralized* | -0,5 | 0 | 0 | -1 |
| *Decentralized* | -1 | -0,5 | 0 | 1 |

Table 11 – Boutique type scores according to order band and boutique type

**Distance to Limit**

This factor measures directly how close the boutique was to underperform the day before. To measure this, the percentage of orders sent the day before with a speed of sending between 1,8 days and 2 days is used. This Speed of Sending range (between 1,8 days and 2 days) is called, from now on, the limit zone. It is expected that the greater the percentage of orders is on the limit zone in day "n" the more the boutique is prone to underperform on day "n+1".

In a situation where a big number of orders was sent within the limit zone it is expected that the boutique will underperform the next day, if there are still many orders on pipeline.

The top 60 boutiques' performance was analysed for the month of March. During it, there were 22 days with deliveries (days where boutiques could underperform). Since 60 boutiques were analysed, this means that there were a total of 1318 days where the boutiques could have underperformed – there was a country with 2 boutiques within the top that had a bank holiday in March. Out of the 1318 days, there were 262 days where the boutiques actually underperformed (the target for March was 96% of orders sent with a SoS<2 days).

On a first overview, it was found that, up until approximately 3% of orders in the limit zone, there was no effect on the next day's performance. With this, it was tested on how many of the 262 days of underperformance the percentage of orders in the limit zone was above 3%. This happened on 134 cases (51,15% of the total).

Since the objective of boutique score is to detect possible boutique underperformance before it happens, the analysis scope was reduced and underperformance days that occur after underperformance days are not included. There are 60 days within the new analysis scope. On 51 cases (85,00% of the total) the % of orders within the limit zone is above 3%. With this data, it was decided that the percentage of orders in the limit zone was going to be used in the boutique score.

To decide which scores and how they should be attributed to the factor, the data was divided in 3 groups according to the percentage of orders sent within the limit zone. The following was concluded:

- There are 12 cases with a percentage of orders sent within the limit zone between 3% and 7%. Out of these, there is no relation in 4 of them (25%). It was decided that days within this range should be treated as having a high probability of underperformance on the next day;
- There are 31 cases with a percentage of orders sent within the limit zone between 7% and 10%. Out of these, there is no relation in 5 of them (16,39%). It was decided that days within this range should be treated as having a very high probability of underperformance on the next day;
- There are 17 cases with a percentage of orders sent within the limit zone above 10%. On all of these the relation was found. It was decided that days within this range should be treated 100% probable of underperforming the next day.

The following scores were defined for this factor, according to the percentage of orders sent within the limit zone. These can be seen in Table 12.

| ***Limit Zone*** | ***0%<X<3%*** | ***3%<X<7%*** | ***7%<X<10%*** | ***X>10%*** |
|---|---|---|---|---|
| *Value* | 0 | 0,75 | 0,9 | 1 |

Table 12 – Distance to limit scores

**Organization**

It is expected that boutiques process its orders according to a first in first out logic as boutiques are instructed to do so. When in a situation of underperformance, the boutiques usually start sending their orders on a more random order disregarding the FIFO logic. A problem with this approach is that orders get processed later than they should have been, increasing the number of orders sent after the target.

The Organization factor is measured in the % of orders not sent with the FIFO rule. It is mathematically expressed as in the equation below:

$$Organization = \frac{Out\ of\ order}{Orders\ Sent} \tag{4.2}$$

Where:

Out of order – number of orders that were sent not following the FIFO rule during the period;

Orders sent – total of sent orders during the period.

To evaluate if the organization factor had an impact in the results, the test procedure adopted for the distance to limit factor was used. It was decided that up until 11% of orders processed not using the FIFO order is acceptable, since that is the total number of orders that are usually placed on hold or have an exception. A boutique creates an exception in an order when something out of their control happens, like the courier transport not passing through the boutique.

The used percentages and respective weights can be seen in the Table 13.

| ***%*** | ***0%<X<11%*** | ***11%<X<25%*** | ***25%<X<50%*** | ***50%<X<75%*** | ***75%<x<100%*** |
|---|---|---|---|---|---|
| *Score* | 0 | 0,25 | 0,5 | 0,75 | 1 |

Table 13 – Possible scores for the organization factor

**Pickup Hour**

The pickup hour is one of the most defining features of a boutique's setup. Except in periodic cases, the pickup occurs every day around the same time, since the courier companies have established daily routes. Given this fact, All in One and Decentralized boutiques can adapt their workforce and workload distribution, in order to maximize the number of daily processed and sent orders.

It is expected that, if the courier company arrives much earlier than the usual pickup courier, the boutique will send a smaller number of orders that day. Also, the orders that would have been sent that day, can only be shipped the next day which might increase the number of orders sent with a speed of sending net above 2 days and ultimately lead to boutique underperformance.

If the pickup hour is after the usual time, the boutique might not have the same workforce available around the pickup hour and might have processed less orders per hour than they would have if the pickup was scheduled for the hour it occurred. Still, the boutique sends more orders than they normally would have sent which decreases the pipeline for the next day.

The above mentioned situations do not affect centralized boutiques the same way. Given the need of centralizing items, the workload distribution cannot be adapted. Also, the sooner the pickup occurs, the sooner the boutique must centralized the items and more items will not be processed and sent that day. This might increase the number of orders sent above the SLA Speed of sending and leads to boutique underperformance. After collecting the opinions of several AM and PS, it was found that centralized boutiques are more likely to underperform if the pickup is before late afternoon – considered 5 pm here.

Taken what was explained before into consideration, it was decided that the Pickup Hour factor would be included in the indicator and the values attributed can be seen in Table 14. The situations that are not mentioned in the table are attributed a value of 0.

| ***Boutique Type*** | ***Situation*** | ***Score*** |
|---|---|---|
| All in One | Pickup the day before, at least 2 hours before the supposed | -0,25 |
| Centralized | Pickup hour before 5pm | -0,25 |
| Decentralized | Pickup the day before, at least 2 hours before the supposed | -0,25 |

Table 14 – Pickup hour scores by boutique type

**Average Orders per employee**

Empirically one can assume that a lower average of orders per employee is related to a better boutique performance, since there is more time available to process each order. The number of employees each boutique has working on order processing is not constant. For example, some boutiques allocate extra employees from the shop floor to the order processing, when needed. Also, other boutiques have employees that are not entirely dedicated to Farfetch.

Therefore, there would be the need to determine how many work hours were dedicated to Farfetch each day by each boutique. Since this is not possible, given the level of operational information the boutiques are willing to share, this factor is not used in the boutique score.

### 4.3.2 Boutique Score Testing

Boutique score can be expressed mathematically as in equation below:

$$Boutique\ Score = \sum_{i=1}^{4} (Wi * Fi) \tag{4.3}$$

Where:

Wi – the weight of the factor i;

Fi – the score of the factor i;

In the boutique score, each factor has a weight associated and each factor is attributed a value, according to the explained above conditions. From the values that can be given to factor, the

lower the boutique score is the more the boutique is prone to underperform the next day. As mentioned before, Boutique score was tested during two free shipping campaigns, one during late April and the other during mid-May.

During both campaigns, and for each day, the boutique score was calculated for every store in the top 60. Several weight combinations for each factor were tested daily. The boutique score values achieved by the boutiques were compared to whether the boutique underperformed or not.

To evaluate which combination was the best, the following 3 parameters were calculated:

- The underperformance value – the highest boutique score from the boutiques that actually underperformed that day. On other words, all the boutiques that underperformed had either an equal or lower boutique score than he underperformance value;
- How many boutiques had a boutique score lower than the underperformance value – boutiques within the underperformance region;
- How many of these effectively underperformed on the next day;

The best combination of factors weights would be the one that had only had the boutiques that underperformed the next day within underperformance region. In case such combination does not exist, the used combination should be the one that has the less boutiques that did not underperformed within the underperformance region.

The chosen combination can be seen on Table 15.

| *Factor 1* | *Factor 2* | *Factor 3* | *Factor 4* |
|---|---|---|---|
| 0,125 | 0,125 | 0,5 | 0,25 |

Table 15 - Chosen combination of weights for Boutique Score

It was the combination that performed the best in all but one of the analysed days. The results it achieved by day can be seen on Table 16.

| *Day* | *Underperformance Value* | *Boutiques within the underperformance region* | *Boutiques within the underperformance region that did not underperform* |
|---|---|---|---|
| 1 | -15% | 3 | 1 |
| 2 | -18% | 5 | 1 |
| 3 | -17% | 8 | 2 |
| 4 | -7% | 2 | 0 |
| 5 | -20% | 5 | 3 |
| 6 | -19% | 9 | 2 |

Table 16 - Chosen combination of weights performance

The day in which the chosen combination of weights was not the best was on day 5, where 60% of the boutiques within the underperformance region did not underperform. With the data from these tests, it was decided that all the boutiques that presented a boutique score value below -15% should be analysed.

The boutiques that did not underperform the next day and had a low boutique score, are usually boutiques that had a big volume of orders on the pipeline and sent most of them. A relevant portion of the orders sent had a Speed of Sending of almost 2 days. This way, the next day's pipeline would consist of almost only new orders that would be within the target of 2 days.

# 5 Conclusions and Future Projects

A company that fails to reach its costumers expectations is a company doomed to fail. The luxury fashion consumer is a demanding one and expects nothing less than an exceptional first rate service. A speedy delivery, beautifully packed and a well-designed customer service become basic requirements in the luxury fashion business.

Recognizing the importance of the partner boutiques, Farfetch is developing new tools for them. These promote and allow a better integration between Farfetch's business and its suppliers, the boutiques.

## 5.1 Main Results and Conclusions

With the tools developed during this project, Farfetch is now able to change its attitude regarding boutique's performance from reactive to proactive.

Using the tools explained in section 4.1 and 4.2, Farfetch can now inform the boutiques of:

- The boutique's actual processing capacity and when the boutique was working at its full capacity
- What should their processing capacity be for a determined period;
- What was the maximum amount of orders the boutique has ever sent and when did this happen.

By crossing the information of what their processing capacity needs to be and what their current processing capacity is, the boutique is able to know if they need to increase their capacity. Another important advantage taken from these information, is that Farfetch can now better plan its marketing campaigns so the boutiques are still able to perform accordingly, with the increased demand. This way, Farfetch is able to obtain the maximum return possible from its operations.

By knowing when they were working at their full capacity, they are able to know how many people they had and how many hours they were working to achieve those results. With the information of the maximum amount of orders they have ever sent and when it happened, they can find what were the resources used and the hours they worked to achieve that result. Using this information, the boutiques can make more informed decisions on what should they should do to cope with increased demand, namely during sale season.

Although working in close collaboration with Farfetch, the partner boutiques are still independent and might not follow Farfetch's instructions. This means that even if a boutique is informed and knows that their processing capacity is not enough, they still can do nothing. Still, for the SS15 sale season, the majority of the boutiques reinforced their teams. They also planned their extra working hours during the weekend, according to the forecasted demand and the resources they have.

The overall Speed of Sending results improved significantly when compared to the AW14 sale season, as it can be seen in Figure 22. Also, they were consistently above the target defined by the company.

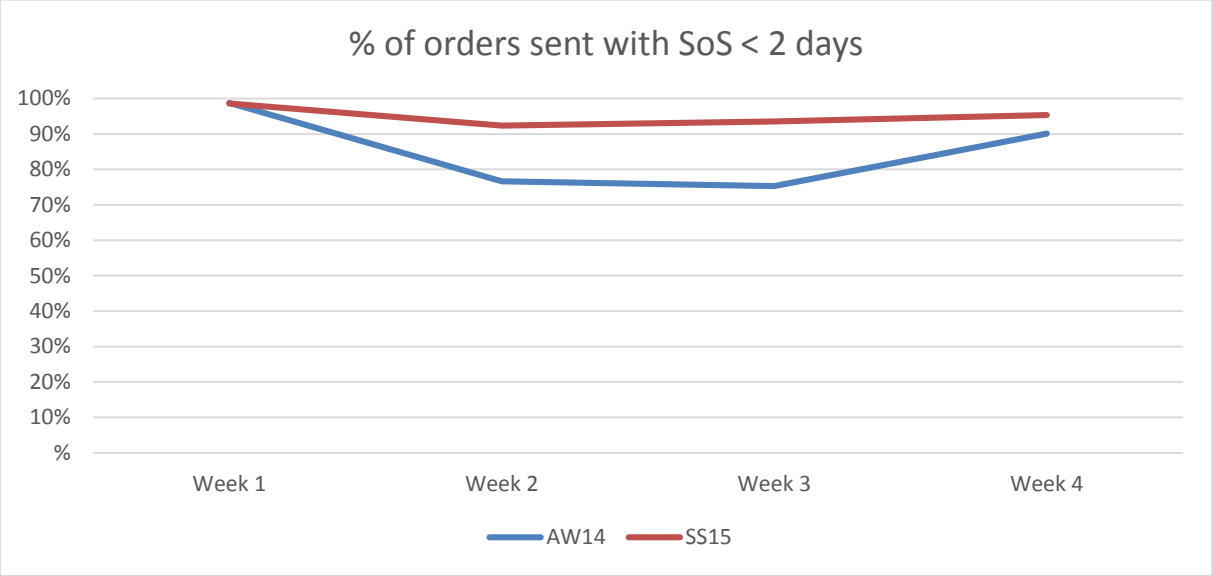



Figure 22 – SLA Speed of Sending comparison between AW14 and SS15

The sale season is marked by a major influx of new orders and new customers. Improved performance and speed of delivery were reflected in a better perception of Farfetch's service, which is revealed by the Net Promoter Score. As expected, the NPS results behaved according to the speed of sending results. Given the direct relationship between the NPS and the repurchase rate, Farfetch's business benefited from the performance results achieved during SS15 sale season. The visual comparison between the NPS achieved during the first 4 weeks can be seen on Figure 23.

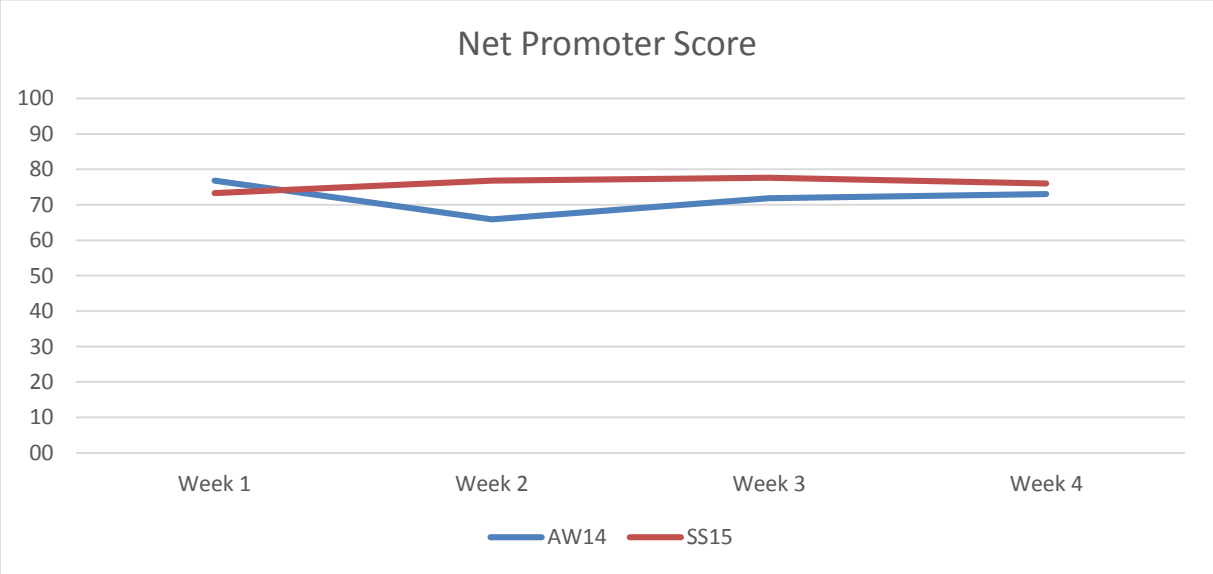



Figure 23 - Net Promoter Score comparison between AW14 and SS15

Performance measurement is an ever evolving task. Companies should not stop testing and improving their KPI and indicators. Currently, it is not possible to conclude if a boutique will underperform, directly from their Boutique Score. Still it is a good predicitve indicator of which boutiques might be a problem. If the boutique score is calculated early in the day, it is possible

to analyse which of these boutiques are most likely to underperform and the information can be passed to the responsible PS. Then, he can warn the boutique of their situation and they can adopt measures like working some extra hours that day, or trying to delay the pickup so more orders can be processed and shipped.

The results obtained through the daily usage of the boutique score and the real results should be analysed. With them, valuable conclusions can be drawn that help with the remodelling of the used factor weights and scores. In the future, when the boutique score results become more reliable, a system of automatic alerts to the boutiques can be set. Meanwhile, a dashboard showcasing the boutique score information of each boutique should be designed. The dashboard should allow drill down options by boutique PS. It should also allow the visual comparison through graphical display, of the boutique score evolution in the last days.

## 5.2 Further Developments

Farfetch's main responsibility is to its customer. Given the growth and expansion of the business one of the company's most crucial challenges is continuing to ensure that its partner boutiques are able to deal with the demand. Therefore, new tools and mechanisms that help boutiques must be developed.

The boxes and duct tape used to pack the items are designed by Farfetch and stocked by the company in 3 different places. The material is requested by the boutiques and takes a few days to reach the store, depending on the distance between the place where the material is stocked and the boutique. Currently there is almost no control on how many boxes each boutique has in stock. If the boutique is not careful enough, it might run out of boxes before a new replenishment shipment arrives, which leads into delays on the order processing. To avoid these situations a stock control tool for the boxes should be developed. With the usage of such system, the frequency of situations where a boutique can't process orders because it has no material would be drastically reduced. Therefore, the boutiques' overall performance would increase.

This tool should be fully integrated with Farfetch's systems and keep record on real time of how many boxes of each type the boutique has. When the quantity of one of the box's type starts to get low, the tool should generate alerts to the boutique. If the boutique doesn't reorder and the quantity keeps getting lower, the system must automatically order a replenishment of boxes to the boutique. Currently, to order a replenishment, boutiques fill a form and send it to Farfetch via their PS. To fasten this process, along with the tool, a new module for boxes ordering should be developed and integrated in the partner boutique's FFDM.

During the development of this project, it was found that some features of the boutique setup deliver better results if, for example, the boutique has a large volume of orders. More relations between the features of the boutique setup and the boutique performance should be researched, validated and tested. With these relations, it will be possible to define recommended setups. This way, when a new boutique joins Farfetch the definition of its setup will be much easier. Also, it will help answering another important question that is: when should a boutique change its setup. For example, it might help to figure out from how many daily orders a centralized boutique should start shipping orders from all its stores (thus becoming a decentralized boutique). With such definition, new boutiques would be more able to deliver better results from the beginning of their collaboration with Farfetch. Also, it would be possible to proactively adapt setups, before the boutiques start to underperform.

Usually smaller boutiques have their employees do both Farfetch and non Farfetch related tasks. This means that, if the boutique's brick and mortar space has an increase in workload, the employees will have less time to process orders. The periods with more movement on the boutiques' physical space usually match the ones with more online movement – the sale season. This leads to a decrease in the order processing capacity and consequently an increase in the

number of late orders. Since service 2.0 is active, boutiques might end up losing a big share of their profits on penalizations. Therefore, it might be more profitable hiring a new person that will only deal with Farfetch tasks. As a future work, former situations like the one described should be analysed. With these, guidelines for when a boutique should hire their first employee entirely dedicated to Farfetch tasks, can be defined.

During this project, it was possible to acknowledge that some boutiques perform really well in some of the processes. For example, there is a boutique that manages to process and ship approximately 95% of their orders in less than a day. These various boutiques should be visited and analysed *in loco*. With the gathered information, best practices for Farfetch's several processes can be defined. This future work, should be done by a team composed of members from the supply team, from the AM department and from the PS department. A proposed methodology could be:

- Identify which boutiques perform consistently over what should be expected from them, comparing them to other boutiques with the same characteristics;
- Identify in which processes these boutiques excel;
- Visit the boutiques, analyze and map the processes and workflow of these boutiques;
- Define why these processes are better done and document the best practices.

A persistent problem throughout the entire project was the fact that it was not possible to infer how much time it took the boutique to pack an item. This limits the extent of the analysis that can be made. More accurate and direct information about the packing time allows better counselling to the boutiques, on how many employees they should have working for Farfetch tasks.

As a future work, the PS should measure how much time some of the tasks took, while visiting a boutique. To guarantee that the measuring process is uniform and done the same way by every PS, it should be defined and standardized by the supply team. Some of the tasks that should be measured are: the packing time, the picking time and the printing the documents time. To complement the new information, data should be kept on when a boutique works extra hours and extra weekdays. These information should be obtained directly from the boutiques and stored in the DB.

## References

Abe, M., Jeng Jun-Jang, and Y. Li. 2007. "A Tool Framework for KPI Application Development". Paper presented at e-Business Engineering, 2007. ICEBE 2007. IEEE International Conference on. 24-26 Oct. 2007.

Anjard, Ronald P. 1996. "Process mapping: one of three, new, special quality tools for management, quality and all other professionals." *Microelectronics Reliability* no. 36 (2):223-225. http://www.sciencedirect.com/science/article/pii/0026271495000546.

Bal, Jay. 1998. "Process analysis tools for process improvement." *TQM Magazine* no. 10 (5):342-354. http://dx.doi.org/10.1108/09544789810231225.

Bjørn-Andersen, Niels, and Rina Hansen. 2011. "The adoption of Web 2.0 by luxury fashion brands." *KMIS & Conf-IRM International Conference 2011: Service Management and Innovation with Information technology*.

Cai, Jian, Xiangdong Liu, Zhihui Xiao, and Jin Liu. 2009. "Improving supply chain performance management: A systematic approach to analyzing iterative KPI accomplishment." *Decision Support Systems* no. 46 (2):512-521. http://www.sciencedirect.com/science/article/pii/S0167923608001693.

Cao, Bin, and Qiang Ye. 2007. "B2C e-commerce's customer relationship management based on the long tail". Paper presented at 2007 International Conference on Management Science and Engineering, 20-22 Aug. 2007, at Piscataway, NJ, USA.

Chen, Injazz J, and Antony Paulraj. 2004. "Towards a theory of supply chain management: the constructs and measurements." *Journal of Operations Management* no. 22 (2):119-150.

Christopher, Martin. 1999. "Logistics and Supply Chain Management: Strategies for Reducing Cost and Improving Service (Second Edition)." *International Journal of Logistics Research and Applications* no. 2 (1):103-104. Accessed 2015/05/16. http://www.tandfonline.com/doi/abs/10.1080/13675569908901575.

Davison, Robert, and Dennis Tse. 1999. "The balanced scorecard: a foundation for the strategic management of information systems." *Decis. Support Syst.* no. 25 (1):71-88.

de la Rosa de Saa, S., M. A. Gil, G. Gonzalez-Rodriguez, M. T. Lopez, and M. A. Lubiano. 2015. "Fuzzy Rating Scale-Based Questionnaires and Their Statistical Analysis." *Fuzzy Systems, IEEE Transactions on* no. 23 (1):111-126.

Doss, F., and T. Robinson. 2013. "Luxury perceptions: luxury brand vs counterfeit for young US female consumers." *Journal of Fashion Marketing & Management* no. 17 (4):424-39. http://dx.doi.org/10.1108/JFMM-03-2013-0028.

Gang, Xiong, Qin Tao, Wang Feiyue, Hu Lei, and Shi Qingsong. 2010. "Design and improvement of KPI system for materials management in power group enterprise". Paper presented at Service Operations and Logistics and Informatics (SOLI), 2010 IEEE International Conference on. 15-17 July 2010.

Gimenez, Cristina. 2006. "Logistics integration processes in the food industry." *International Journal of Physical Distribution & Logistics Management* no. 36 (3):231-249. http://www.emeraldinsight.com/doi/abs/10.1108/09600030610661813.

Husic, M., and M. Cicic. 2009. "Luxury consumption factors." *Journal of Fashion Marketing & Management* no. 13 (2):231-45. http://dx.doi.org/10.1108/13612020910957734.

Indulska, Marta, Jan Recker, Michael Rosemann, and Peter Green. 2009. "Business Process Modeling: Current Issues and Future Challenges." In *Advanced Information Systems Engineering*, edited by Pascal van Eck, Jaap Gordijn and Roel Wieringa, 501-514. Springer Berlin Heidelberg. http://dx.doi.org/10.1007/978-3-642-02144-2_39.

Ittner, Christopher D., David F. Larcker, Venkatesh Nagar, and Madhav V. Rajan. 1999. "Supplier selection, monitoring practices, and firm performance." *Journal of Accounting and Public Policy* no. 18 (3):253-281. http://www.sciencedirect.com/science/article/pii/S0278425499000034.

Jan, Mouritsen, Skjøtt-Larsen Tage, and Kotzab Herbert. 2003. "Exploring the contours of supply chain management." *Integrated Manufacturing Systems* no. 14 (8):686-695. Accessed 2015/05/16. http://dx.doi.org/10.1108/09576060310503483.

Kapferer, J.N., and V. Bastien. 2009. *The Luxury Strategy: Break the Rules of Marketing to Build Luxury Brands*: Kogan Page.

Krause, Daniel R., Thomas V. Scannell, and Roger J. Calantone. 2000. "A Structural Analysis of the Effectiveness of Buying Firms' Strategies to Improve Supplier Performance." *Decision Sciences* no. 31 (1):33-55. http://dx.doi.org/10.1111/j.1540-5915.2000.tb00923.x.

Kwong, C.K., W.H. Ip, and J.W.K. Chan. 2002. "Combining scoring method and fuzzy expert systems approach to supplier assessment: a case study." *Integrated Manufacturing Systems* no. 13 (7):512-519. http://www.emeraldinsight.com/doi/abs/10.1108/09576060210442671.

Larraufie, and Aurélie Kourdoughli. 2014. "The e-semiotics of luxury." *Journal of Global Fashion Marketing* no. 5 (3):197-208. Accessed 2015/04/07. http://dx.doi.org/10.1080/20932685.2014.906120.

Li, Suhong, S. Subba Rao, T. S. Ragu-Nathan, and Bhanu Ragu-Nathan. 2005. "Development and validation of a measurement instrument for studying supply chain management practices." *Journal of Operations Management* no. 23 (6):618-641. http://www.sciencedirect.com/science/article/pii/S0272696305000501.

Liu, Na, Shuyun Ren, Tsan-Ming Choi, Chi-Leung Hui, and Sau-Fun Ng. 2013. "Sales Forecasting for Fashion Retailing Service Industry: A Review." *Mathematical Problems in Engineering* no. 2013:9. http://dx.doi.org/10.1155/2013/738675.

Liu, Ying, Lijun Xue, and Wei Su. 2009. "Designing Supply Chain KPIs for Upper-Level Management". Paper presented at Services Science, Management and Engineering, 2009. SSME '09. IITA International Conference on. 11-12 July 2009.

Meyliana, H. A. E. Widjaja, and S. W. Santoso. 2014. "University dashboard: An implementation of executive dashboard to university". Paper presented at Information and Communication Technology (ICoICT), 2014 2nd International Conference on. 28-30 May 2014.

Mouritsen, Jan, Tage Skjøtt-Larsen, and Herbert Kotzab. 2003. "Exploring the contours of supply chain management." *Integrated Manufacturing Systems* no. 14 (8):686-695. http://www.emeraldinsight.com/doi/abs/10.1108/09576060310503483.

Okonkwo, Uche. 2009. "Sustaining the luxury brand on the Internet." *J Brand Manag* no. 16 (5-6):302-310. http://dx.doi.org/10.1057/bm.2009.2.

Paulraj, Antony, and Injazz J. Chen. 2005. "Strategic Supply Management and Dyadic Quality Performance: A Path Analytical Model." *Journal of Supply Chain Management* no. 41 (3):4-18. http://dx.doi.org/10.1111/j.1055-6001.2005.04103002.x.

Prajogo, Daniel, Mesbahuddin Chowdhury, Andy C. L. Yeung, and T. C. E. Cheng. 2012. "The relationship between supplier management and firm's operational performance: A multi-dimensional perspective." *International Journal of Production Economics* no. 136 (1):123-130. http://www.sciencedirect.com/science/article/pii/S0925527311004087.

Reiman, Teemu, and Elina Pietikäinen. 2012. "Leading indicators of system safety – Monitoring and driving the organizational safety potential." *Safety Science* no. 50 (10):1993-2000. http://www.sciencedirect.com/science/article/pii/S0925753511001688.

Sarkar, Ashutosh, and Pratap K. J. Mohapatra. 2006. "Evaluation of supplier capability and performance: A method for supply base reduction." *Journal of Purchasing and Supply Management* no. 12 (3):148-163. http://www.sciencedirect.com/science/article/pii/S1478409206000665.

Sharma, D. K., Hitesh, and V. Rao. 2014. "Configurable Business Process Modeling Notation". Paper presented at 2014 IEEE International Advance Computing Conference (IACC), 21-22 Feb. 2014, at Piscataway, NJ, USA. http://dx.doi.org/10.1109/IAdCC.2014.6779535.

Theeranuphattana, Adisak, and John C.S. Tang. 2007. "A conceptual model of performance measurement for supply chains." *Journal of Manufacturing Technology Management* no. 19 (1):125-148. http://www.emeraldinsight.com/doi/abs/10.1108/17410380810843480.

Weske, M., W. M. P. van der Aalst, and H. M. W. Verbeek. 2004. "Advances in business process management." *Data & Knowledge Engineering* no. 50 (1):1-8. http://dx.doi.org/10.1016/j.datak.2004.01.001.

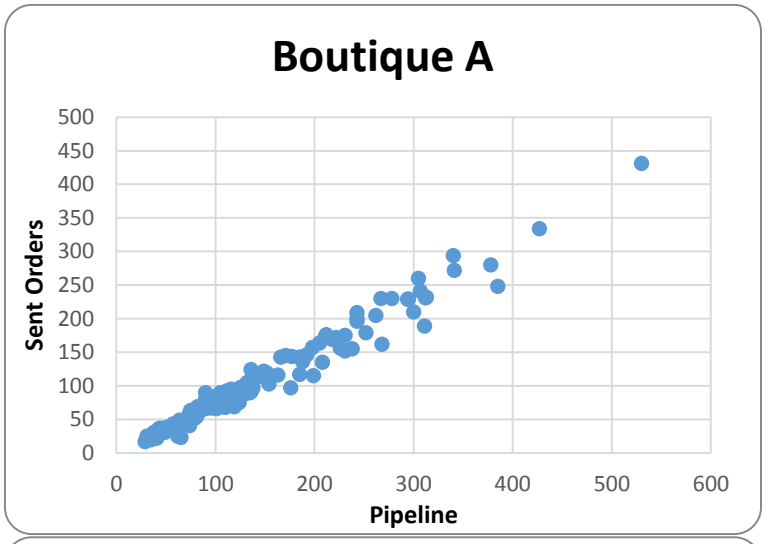
Xuan, Zhang, and Liu Yuanzhang. 2007. "The Impact of ICT on Supplier-Buyer Relationship in Different Types of Supply Chain". Paper presented at Wireless Communications, Networking and Mobile Computing, 2007. WiCom 2007. International Conference on. 21-25 Sept. 2007.

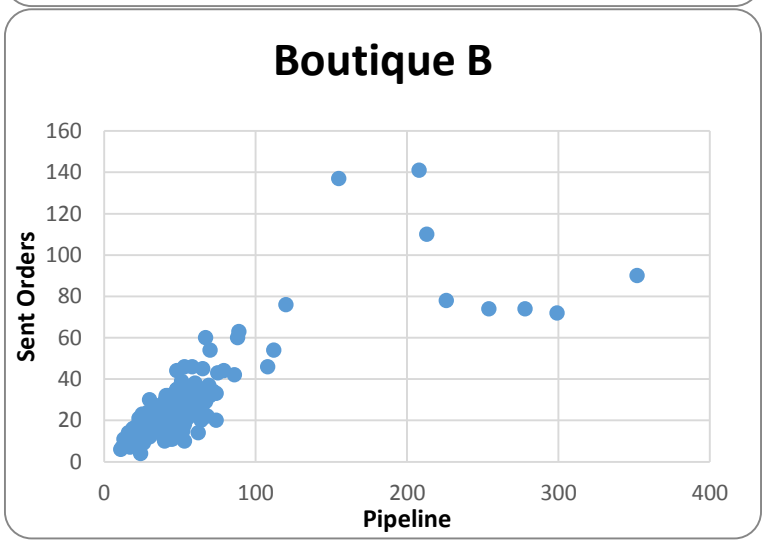
Yan, Peng, Wang Suozhu, and Zhuang Like. 2008. "Balanced Scorecard-Based Management System for Performance Evaluation of Organizations". Paper presented at Pervasive Computing and Applications, 2008. ICPCA 2008. Third International Conference on. 6-8 Oct. 2008.

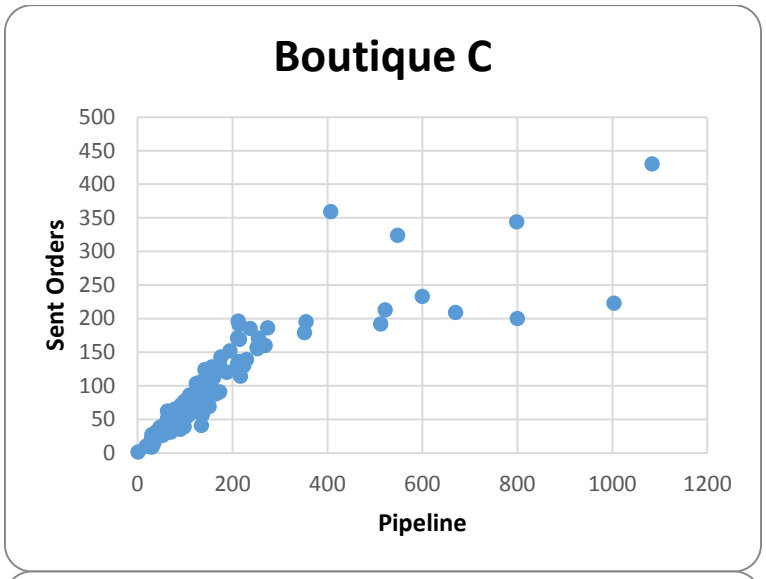
Yesil, E., M. Kaya, and S. Siradag. 2012. "Fuzzy forecast combiner design for fast fashion demand forecasting". Paper presented at Innovations in Intelligent Systems and Applications (INISTA), 2012 International Symposium on. 2-4 July 2012.

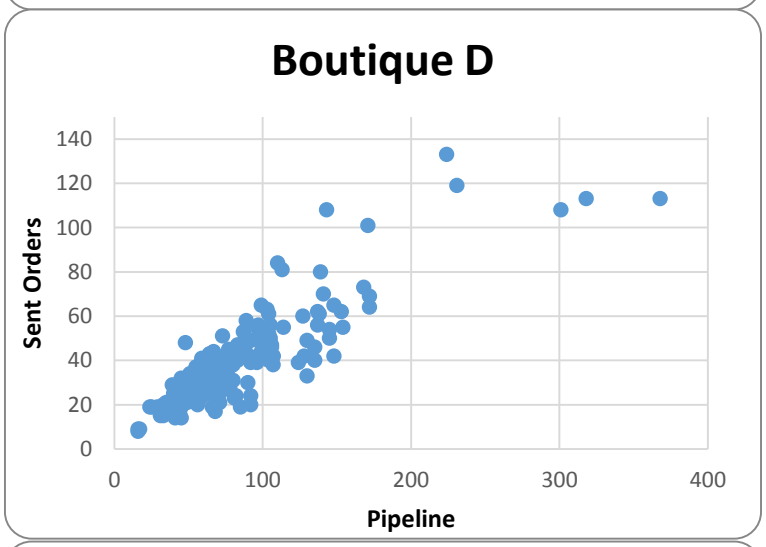
Yu, Yong, Tsan-Ming Choi, and Chi-Leung Hui. 2011. "An intelligent fast sales forecasting model for fashion products." *Expert Systems with Applications* no. 38 (6):7373-7379. http://www.sciencedirect.com/science/article/pii/S0957417410014521.

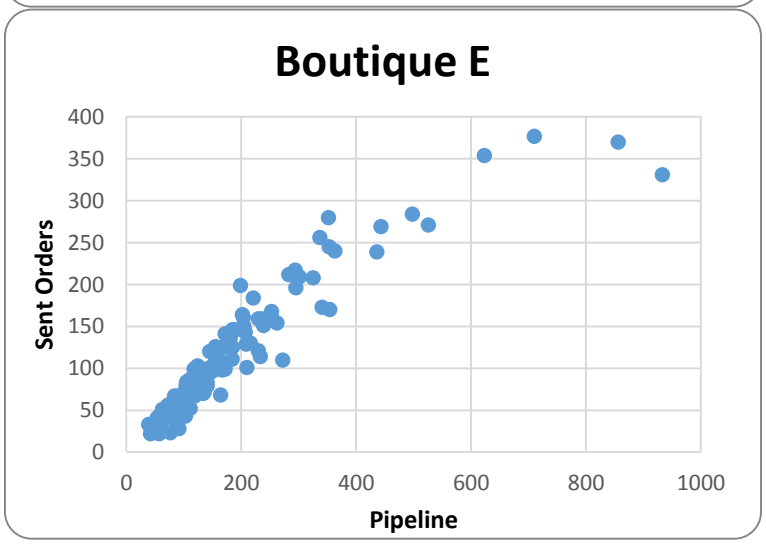
## Appendix A - Graphs with outliers

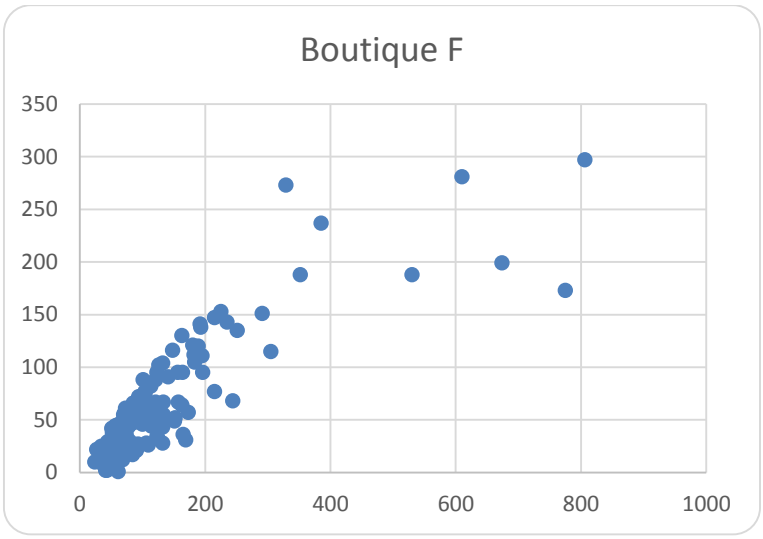


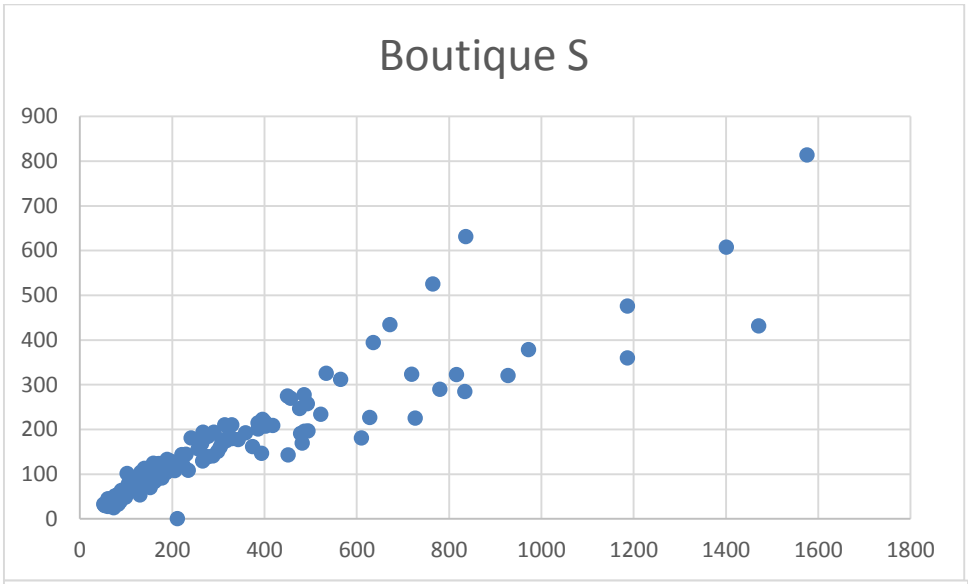

Boutique C
Sent Orders
500
450
400
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
1200
Pipeline

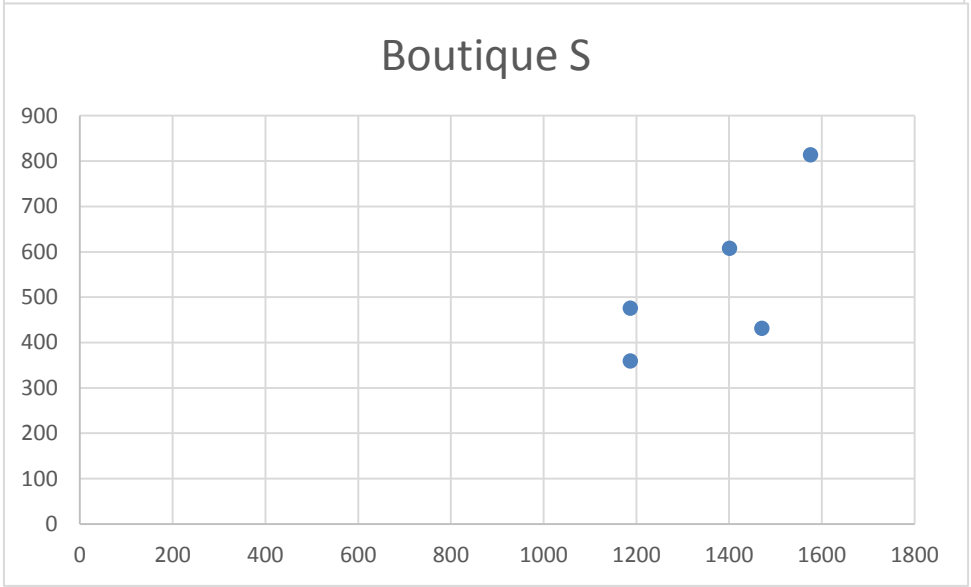

Boutique D
Sent Orders
140
120
100
80
60
40
20
0
0
100
200
300
400
Pipeline

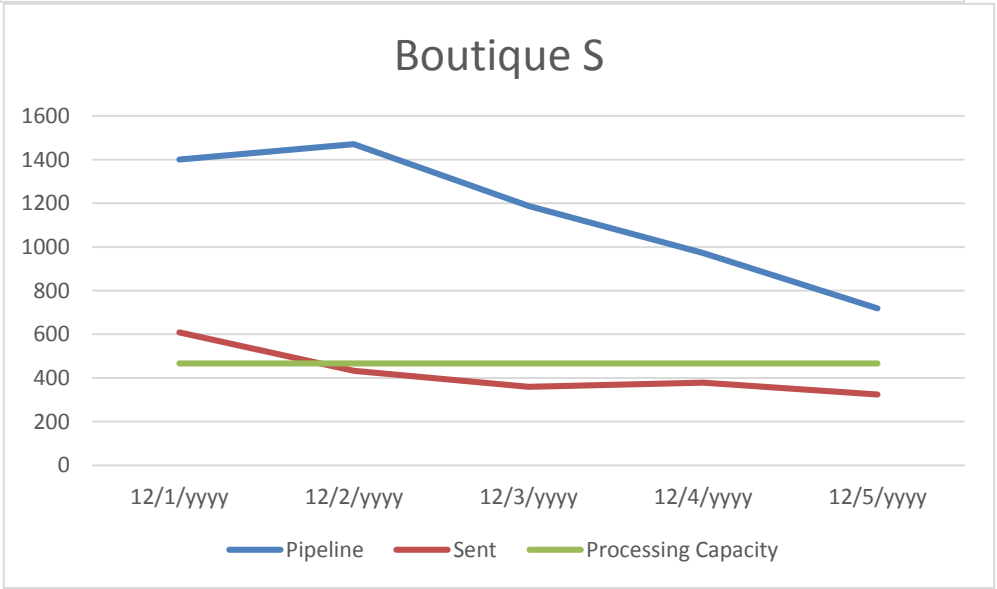

Boutique E
Sent Orders
400
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
Pipeline


Boutique F
350
300
250
200
150
100
50
0
0
200
400
600
800
1000

## Appendix B - Graphs example



# Appendix C - Boutique Capacity Assessment query

```
select
        BO.sigla + cast(g.orderID as varchar) as BoutiqueOrder,
        g.DataCriado as DataCriado,
        step5.date as Sent,
        sos.BISoS

from GLBorders (nolock) g

inner join BOLocais bo (nolock) on g.SiteID = bo.localID

left outer join

(SELECT        SiteID, OrderID, MAX(date) AS date
                        FROM            BI_SYNC.dbo.FarOrderLog (nolock) g

                        WHERE        (text IN ('Status Change: Sent'))
                        GROUP BY SiteID, OrderID) AS step5 on g.SiteID = step5.SiteID AND g.OrderID = step5.OrderID

left join [dbo].[OMSSpeedOfSend] sos (nolock) on g.SiteID=sos.SiteId and g.OrderID=sos.OrderId

WHERE g.SiteID =9474 and step5.date is not null
order by g.DataCriado
```